Popular Science

★ FOUNDED MONTHLY 1872

INVENTIONS
DISCOVERIES
RADIO
AUTOMOBILES
AVIATION
HOME WORKSHOP

NOVEMBER

Where every day's work is a gamble with death. *See page 18*

25 CENTS

In this Issue—Houdini's Own Story

This husky hammer makes hard hitting easy

SOLID blows without effort! When you work on metal ... drive a cold chisel or a punch ... spread a rivet ... cut a gasket ... work around the car ...

Do the hard hitting easily with a Plumb ball pein.

See the weight of metal behind that tough face. See how the whole head is mounted off-center to add power.

See the sturdy mounting of the black head on the red handle—the oblong eye takes the handle full-size.

The pein is cone-shaped, not round. It spreads rivets instead of mashing them.

And there is the Take-Up Wedge (exclusive Plumb invention). If ever a hammer needed a tight head, this one does.

A tight head is assured on this, and any, Plumb Tool, with a turn of the wrist on the Take-Up Wedge.

To improve your work, to make hard hitting easy and safe, swing a Plumb Ball Pein Hammer.

FAYETTE R. PLUMB, Inc.
Philadelphia, U. S. A.

The Plumb Ball Pein Hammer. At good hardware stores everywhere. 1 lb., $1.00; 1½ lb., $1.15; 2 lb., $1.30 (except in Far West and Canada).

A Real Long Range Crosley Receiving Set $9.75

Do not assume from its very interesting price that this very unusual Crosley set is a toy. Its impressive performance alone entitles it to serious consideration.

Heretofore, the $10 radio was designed only for local reception. Now the Crosley Pup extends the entertainment radius to 1500 miles under ordinary conditions. Place it beside some costly multiple-tube set and operate the dials. Both tune through local stations sharply. Both get the same programs with equal ease and clarity. Both let you tap the infinite enjoyment coming through the air. There is only one difference—the Pup operates with head phones instead of a loud speaker.

The Pup is the newest Crosley set with a price that reflects the volume-production economies of the world's largest builder of radios. It is substantially constructed and permanent in every regard. Its design is an improvement of the famous Crosley one tube set with which Leonard Weeks of Minot, N. D., heard the MacMillan Polar Expedition while the rest of America listened in vain.

Almost overnight the Pup has become the most popular Crosley set ever offered. It is being bought for youngsters whose curious fingers cannot resist the lure of dials and switches; for the cook, the maid, the old folks back home, and for shut-ins. Traveling men are selecting it because of its easy portability, and radio enthusiasts to have an inexpensive check on their large sets. Hear it once—and you will own one too!

In addition to the Pup, there is a Crosley for every price and preference. Operating 1, 2 and 3 tubes, these are encased in handsome Crosley-built cabinets and range in price up to the Super-Tirdyn Special which retails for $60. Each will deliver the superlative performance that has made the word "Crosley" a hall mark of radio perfection in millions of homes throughout the world.

The CROSLEY *Pup - $9.75*

Crosley manufactures receiving sets which are licensed under Armstrong U. S. patent No. 1,113,149 and priced from $9.75 to $60.00 without accessories. None of the prices quoted include batteries, tubes, headphones, etc. Add 10% to all prices west of the Rocky Mountains.

THE CROSLEY RADIO CORPORATION
CINCINNATI, OHIO

Owning and operating WLW, first remote control super-power broadcasting station

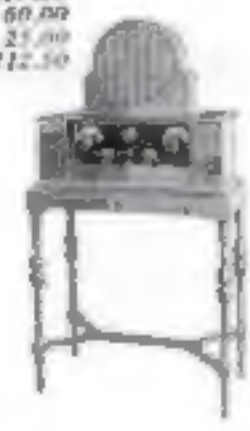
Crosley De Luxe Combination

Marionne De Luxe - $27.50
Super-Tirdyn Special 60.00
Console Table - - 25.00
Complete - - 112.50

Crosley 3 Tube 52 S. D. Mahogany finished cabinet, sloping panel. Holds all batteries $32.50

Crosley Super-Tirdyn Regular More compact than the Special Model—but exactly the same superb performance - $50.00

Crosley Super-Tirdyn Special Matchless performance and exquisite beauty combined. Solid mahogany cabinet with popular sloping panel - - $60.00



Crosley 2 Tube 51 S. D. A true long range set, easy to tune and handsome in appearance $23.50

CROSLEY · RADIO

BETTER · COSTS LESS

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Popular Science Monthly

The Magazine of Invention and Discovery

NOVEMBER, 1925; Vol. 107, No. 5

25 cents a Copy; $2.50 a Year

Published in New York City at

250 Fourth Avenue

Coming Next Month

Pictures from the Clouds—The story of a marvelous school where Uncle Sam trains young photographers in the new science of aerial photography.

How to Get Ready for Christmas—Novel and entertaining ways to make holiday decorations will be described and illustrated in the Home Workshop. Also, toys and games you can make for the boys and girls.

Your Winter Driving Troubles—Simple precautions you can take to save yourself the difficulties encountered in cold weather—useful facts that every motorist wants to know.

More than 200 other fascinating articles and pictures, giving you all the news of radio engineering, science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.

Big Prize Contest for Radio Builders

AMATEUR radio builders are performing wonders these days. Through the aid of exp'icit constructional articles such as appear every month in POPULAR SCIENCE MONTHLY they are learning how to build receivers of remarkable efficiency. Here, for example, is a young man of New Rochelle, N. Y., with a tremendously powerful eight-tube neutrodyne set he has just completed. What kind of a set can you build? Turn to page 59 of this issue for the announcement of a forthcoming cash prize contest for home radio builders. Details of this contest will be announced next month.

POPULAR SCIENCE MONTHLY

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O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

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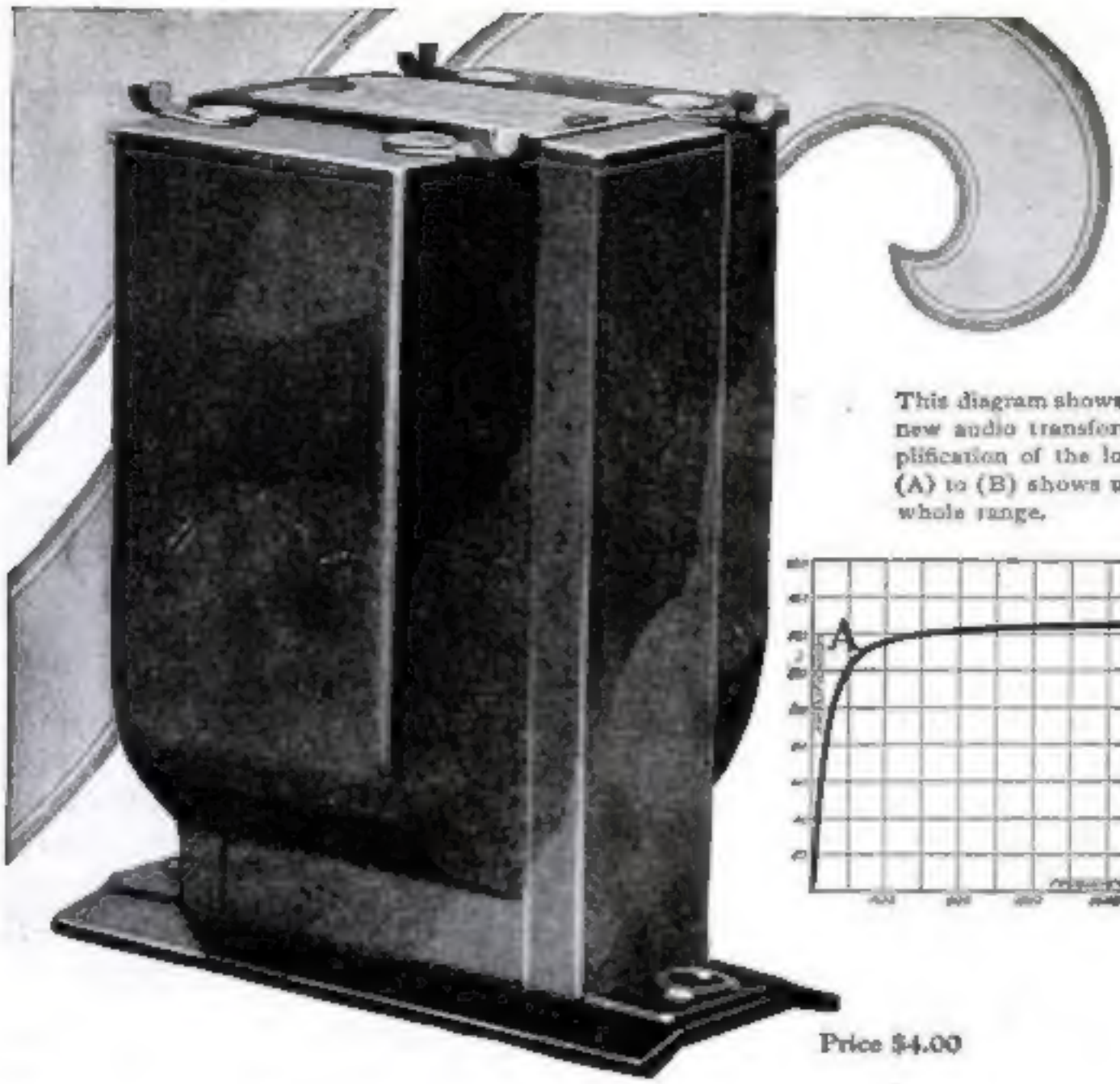
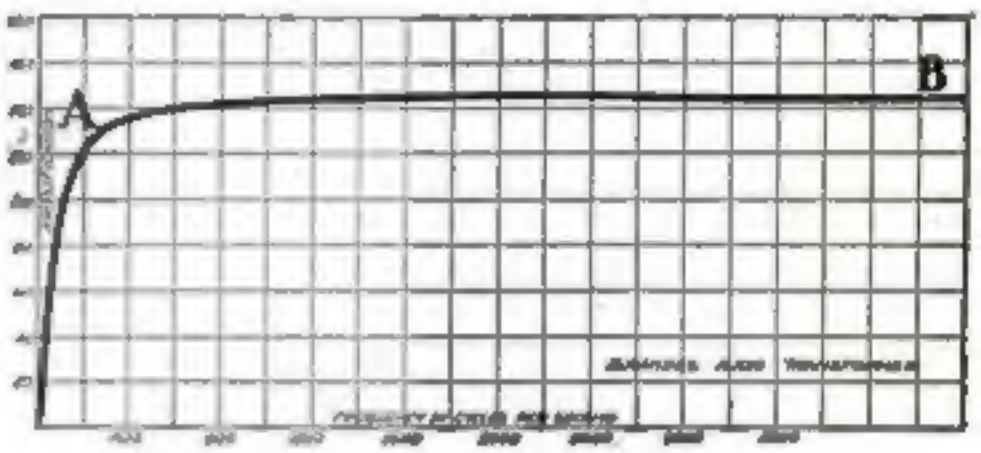


This diagram shows the amplification curve of the new audio transformer. (A) shows the high amplification of the low tones. Straight line from (A) to (B) shows uniform amplification over the whole range.



Price $4.00

New low tones—new high tones with a Brandes Transformer

HERE'S a new audio transformer that "lets through" the deep and the high tones—that gives an *even* amplification over the whole range.

It amplifies at a high ratio of 1 to 5—without any transformer distortion. And its perfect amplification of the overtones gives mellowness and reality.

Send for an interesting booklet describing Acoustics by Brandes.

Prices slightly more west of the Rockies and in Canada

The Type H—a horn of graceful lines and antique green and black finish. Great in volume—true in tone. Adjustable. $18

The Brandes Cabinet Speaker of mahogany, finished in walnut brown. The same unit, quality of tone and even greater volume than the Type-H. $30

The Brandes Cone—a truly decorative bit of furniture that conceals a remarkable speaker $38

Brandes

EXPERTS IN RADIO ACOUSTICS SINCE 1908

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Direct Road to Success

The Money-Making Opportunities Section of* POPULAR SCIENCE MONTHLY *has been established as a service to readers of this magazine

AMONG the announcements of correspondence schools, resident schools, publishers, people wanting agents and the innumerable other advertisements on pages 144 to 174, you may find the very opportunity you have been looking for.

Today the direct road to success is knowledge—not general knowledge, but *specialized* knowledge. To know more about your job than the other man is the first step toward success. The men who succeed have specialized—they have studied, they have learned more about the work they are doing than their fellow workers.

Does your present job hold your interest, or have you always longed to do something different? You can get ahead much faster in a job that you are interested in intensely.

Here is your opportunity to get into the work you have always wanted to do.

Whether your ambition is to be a lawyer or a master carpenter, a salesman or the owner of a garage, an artist or an electrical expert, a public speaker or a pharmacist, there are schools and books advertised in the Money-Making Opportunities Section of POPULAR SCIENCE MONTHLY ready to help you secure the specialized training you need to get ahead.

If you would like to have your own car, your own home, have money in the bank, give your family the best things in life, determine now to be the boss intead of a wage-earner.

Correspondence schools and similar opportunities for specialized study is the way out for the man handicapped by lack of education. And this specialized education can be secured without its interfering with your present employment—and at a cost you can afford.

POPULAR SCIENCE MONTHLY is the great meeting place for men who want to succeed and the schools and publishers that can help these men achieve their ambitions.

Start on page 144 and study every advertisement in the Money-Making Opportunities Section. Decide what most you would like to do and then fill in the coupons or write to the advertisers who are ready to help you *reach the top* of the profession or trade you have chosen.

With specialized training in the field you have selected, and determination to get ahead, you can be a leader instead of a follower. Only through education, plus determination, can you succeed in life.

As a further incentive to start on the road to success, we are offering $100 in Cash Prizes for the best letters telling us the advertisements our readers like best—and why. See the details of this prize offer on page 144.

$100 in Cash Prizes

For the best letters in answer to the questions:

What advertisement in the MONEY-MAKING OPPORTUNITIES SECTION interests you most—and why?

we will pay $100 in cash prizes. For full details—

See page 144

You will find Scores of Opportunities for Making More Money in the "Money-Making Opportunities" Department, starting on page 144 of this issue.

CLARITY

THE OBEDIENT SLAVE TO YOUR DESIRES

FROM the mellow depth to the highest pitch of harmony — the improved APEX Receiving Sets bring in, with startling clarity and naturalness, all of the delicate gradations of the entire range of sound—whether the highest soprano or the deepest of bassos profundo.

The charm of naturalness, combined with greater distance getting ability, positive selectivity and full volume, plus the enchanting elegance of design and finish, present radio receiving sets that are most satisfactory in every element of operation and a real delight to all whose choice of home furnishings is guided by true appreciation of artistic and refined beauty.

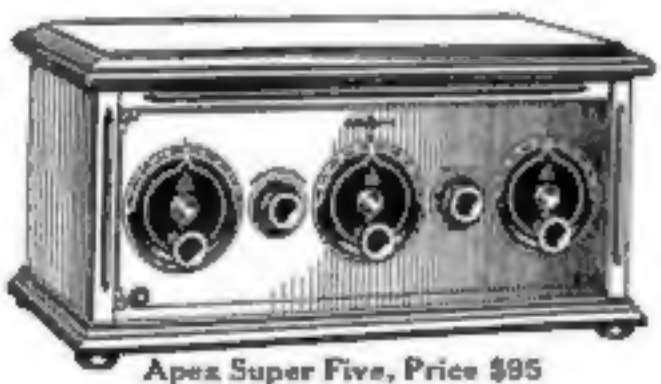
Only a dependable merchant is given the APEX dealer franchise. *Your* APEX dealer will gladly make personal demonstration of APEX Quality Radio Apparatus.

APEX ELECTRIC MFG. CO.
1410 W. 59th Street Dept. 1103
Chicago

Also makers of the famous APEX Vernier Dials and APEX Rheostats, which are sold by every good dealer in Radio.

Upon request, we will gladly mail you descriptive folder.

APEX
Quality Radio Apparatus



Apex Super Five, Price $95
without accessories

Apex De Luxe
Price $135

Apex Console
Entertainer, Price $27.50

Apex Baby Grand Console
Price $225

Apex Utility
Radio Table
Price $75

Apex
Entertainer
Price $22.50

Prices West of Rockies slightly higher. Canadian prices approximately 40% higher.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Expert Advice for the Buyer of Tools or Radio

How the Popular Science Institute of Standards Will Help You with Its Buying Guide

Every item in the Buying Guide has been tested rigorously by experts. The Buying Guide of Approved Radio and Tool Products will be sent on request

THERE is one essential article that always is taken on buying expeditions. That is money. But an increasingly large number of the readers of POPULAR SCIENCE MONTHLY, and their friends, are taking a second companion when buying radio and tool equipment. That is the List of Approved Products of the Popular Science Institute of Standards.

Not having an engineer at their side to advise them in purchasing, they find this list of products that have passed the rigid tests of a staff of expert engineers an able substitute. For, in selecting a product that has been approved by the Popular Science Institute, they know they will get an article of sound quality, efficient construction, and one capable of standing up under usage.

All this has been proved in the Institute laboratories at New York University. There, under the supervision of Prof. Collins P. Bliss, Head of the Department of Mechanical Engineering, Director of Testing Laboratories of that university, and Director of the Popular Science Institute, the tests are conducted. This fact alone insures the thoroughness and impartiality of the Institute's tests.

THE extensive nature of these tests is not always appreciated. Some manufacturers, as well as readers of the magazine, assume that they are made more or less on the "try-out" principle. Only recently, when a certain radio manufacturer was requested to loan a sample loudspeaker for test, he suggested that an engineer from the Institute be sent down to his place to "look it over and try it out," adding that he guessed that was "all that was necessary." Far from it! Actual laboratory tests cover an extended period of time and require the use of complicated testing equipment. In fact, the manufacturer who is anxiously waiting the Popular Science Institute of Standard's certificate of approval often becomes impatient at the delay—from two weeks to three months, according to the nature of the product—required to complete the tests. Should the results of the test be unsatisfactory, the product is disapproved and cannot be advertised in POPULAR SCIENCE MONTHLY.

ANOTHER impression that some people entertain is the belief that the Popular Science Institute tests one product of a manufacturer and passes his whole line on the basis of that test. This is not the case. If a manufacturer advertises a drill in POPULAR SCIENCE MONTHLY one month, that is tested. If, the following month, he wishes to advertise a screwdriver, that, too, is tested before the insertion of the advertisement is allowed. And it is surprising to note the difference in various products made by the same manufacturer. This is especially true in the case of radio apparatus, for continual experimenting is going on, and some equipment is put on the market by reputable manufacturers that requires considerable more experimenting.

LETTERS received by the Institute give evidence that the readers of POPULAR SCIENCE MONTHLY are taking full advantage of the service offered them and are being guided by the results of the tests made by its engineers. In the morning's mail the other day, the following note was received which is just an illustration of how thousands are depending on the Institute's List of Approved Products:

> GENTLEMEN:
>
> Please send me your list of approved products—both tool and radio. I received your list when the Institute was first started and profited much by using it.
>
> This list has since been misplaced and, as I am in the market again, would appreciate your sending your latest list.—W. E. S.,
> New York, N. Y.

The service of the Popular Science Institute of Standards is entirely free to both readers of POPULAR SCIENCE MONTHLY and wholesalers and retailers of Radio and Tool Equipment. Address inquiries, or requests for the List of Approved Products, to the Popular Science Institute of Standards, 250 Fourth Avenue, New York, N. Y.

POPULAR SCIENCE *Monthly* Guarantee

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

THE PUBLISHERS.

When Science Is Used in Making Doughnuts

THE hit-or-miss method of doughnut making, where the old-fashioned baker dipped his dough in an iron pot of bubbling, boiling fat, has been superceded.

Today, doughnuts are made in quantity under scientific conditions. The all important matter of the temperature is gauged accurately by *Tycos* Thermometers. Guess work is eliminated.

The housewife who makes her own doughnuts can obtain the same uniform results that wholesale bakers get by using the Taylor Deep Fat Frying Thermometer.

The same scientific accuracy that has been introduced in the old-fashioned art of doughnut making is available to all manufacturers who use heat treating processes.

Whether you make doughnuts by the thousands, pack boatloads of salmon at a time, can acres of vegetables a day, or bake bread by the mile, there are *Tycos* Instruments that will insure your getting the absolute uniformity of product that is the backbone of doing business on a volume basis.

Taylor Instruments for Indicating, Recording and Controlling heat—the "Sixth Sense of Industry"—has made possible this mechanical age.

To Manufacturers

In the *Tycos* line of 8000 different kinds of Heat Indicating, Recording and Controlling Instruments, there are instruments that will help you get absolute uniformity in your production. It will pay you to learn how other manufacturers are using the Sixth Sense of Industry to get uniform results. Informative literature on any type of instrument will be sent you on request. Or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. • • U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO

Tycos for the Home

***Tycos* Office Thermometers**
An aid in promoting human efficiency.

***Tycos* Bath Thermometers**
To enable you to get the most good from your bath.

***Tycos* Home Set**
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

***Tycos* Wall Thermometers**
To help you maintain a temperature in your house conducive to good health.

***Tycos* Quality Compasses**
To show you the right way in unfamiliar country.

***Tycos* Fever Thermometers**
A necessity in every home.

***Tycos* Stormglass**
Forecasts the weather twenty-four hours ahead with dependable accuracy.

***Tycos* Hygrometer**
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Tycos for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on request.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
November, 1925

The First 68 Prize-Winners

John and Mary Newlywed Announce Results of the June Competition in Our Great

$10,000 Contest

John and Mary
You can see how glad they are to find out about the mistakes they made in doing odd jobs about their new home

THE home-making troubles of John and Mary Newlywed are over. And it is only fair that we now should let this enthusiastic young couple announce the 68 prize-winners in the first of the four Monthly Contests that made up POPULAR SCIENCE MONTHLY'S $10,000 "What's Wrong" Contest.

First of all, John and Mary will introduce you to E. B. Benson, of Rock Island, Ill., winner of the first prize of $500 in the June "What's Wrong" Contest. With his little daughter, he greets you with a smile in the photograph at the foot of this page.

Next, meet Louise Gardiner Walshe, winner of the second prize of $100, and Edwin T. Brown, winner of the third prize of $50. When you turn this page, you will look into their faces.

Finally, in the list at the top of the next page, you will meet the winners of the five prizes of $10 each and the 60 prizes of $5 each. Of course, we'd like to have you see their faces, too, but space does not permit.

The Three Best

THE first three prizes in the June "What's Wrong" Contest have been awarded as follows:

FIRST PRIZE, $500
E. Bernhard Benson, Rock Island, Ill.

SECOND PRIZE, $100
Louise G. Walshe, Jersey City, N. J.

THIRD PRIZE, $50
Edwin T. Brown, Pittsburgh, Pa.

Names of winners of the other 65 prizes will be found on the next page.

Wins the First Prize of $500
E. Bernhard Benson, of Rock Island, Ill., winner of the first prize of $500 in the June Contest, with his little daughter June

All these awards were made by the three official judges after careful consideration of thousands of entries. The surprising thing about the June contest was the large number of readers who sent in correct answers to all of the eight "What's Wrong" pictures, showing John and Mary doing odd jobs about their new home. Contestants were asked to find out from each picture what John or Mary (or both) were doing wrong, and to tell why it was wrong; also what deliberate mistake the artist made in drawing each picture.

The general excellence of the contributions and the fact that so many contestants told exactly what was wrong in each case made the task of choosing the 68 prize-winners a difficult one. In reaching their final decisions, in accordance with the rules of the contest, the judges based their selection of winners on three points—accuracy, clearness, and skill of presentation. A number of those who submitted correct answers failed to win one of the prizes simply because they failed to state their answers clearly and concisely Many other entries that showed painstaking and enthusiastic effort, had to be thrown out because one or more of the answers were inaccurate.

Interest in this remarkable contest has been world-wide, as evidenced by the fact that hundreds of entries arrived from distant countries, including Russia, India, Australia, South America, England, Ireland, and France. Many of the entries showed remarkable ingenuity. A number of contestants, for example, submitted their answers in the form of bound volumes with handsomely designed covers, the contents arranged with pictures of John and Mary carefully pasted on the pages and the answers neatly hand-printed beneath the pictures. Several people redrew all eight pictures of John and Mary to show them in each case doing the job right, and in each correcting our artist's deliberate error A woman painted her own portrait on the cover of her bound entry. Several contestants inclosed their entries behind glass in large frames of their own workmanship

The awards of all cash prizes were made

Additional Prize-Winners in the June Contest

FIVE PRIZES—$10 EACH

H. N. Aldrich, Rosalie, Neb. Louis J. Day, Floral Park, N. Y. Edward J. Frank, Schenectady, N. Y.
Harold W Reaben, Monitor, Oreg. Edwin C. Warren, Washington, D. C.

SIXTY PRIZES—$5 EACH

Harry C Branch, Cleveland, Ohio
Charles Bunting, Santa Cruz Calif
Harry C. Burnham, Creston R I
Jacob H Carmichael Cicero, Ill.
Mrs. W J. Chlevitz Cleveland, Ohio
Harry E. Cook, Delta, Colo.
Mrs. Marvin M Cope, Richmond, Va.
Mrs. John F Costello, Northport Wash.
Samuel Lee Craig, Principio Furnace Md.
Ernest H. Dale, Philadelphia Pa.
Harold F Dawes Petersburg, Alaska
Mrs. Alma R Ewing, Capitan, N M
Dwight V Fisher Vineland N J.
Capt. Wm. Allison Fuller Cocoa Fla.
Joseph C. Gilbert, Providence R I.
George H. Groth, Cleveland, Ohio
Roger Hackney Birmingham Ala.
Carl M Hartman, Toledo, Ohio
C. M. Hind, Seattle Wash.
B. H. Hodges, Bluefield W Va.
W S Hodgins Hampton Va.
Walter J Irvin, Jr Reidsville N. C
Ethel Jacobs, Winnipeg Can.
H J. Johnson, Duluth Minn.
D R Kinports, Cheyenne Wyo.
Reuben Kock, Dayton, Ohio
Ralph J Leonard, St Louis, Mo.
D W Livingston Milwaukee Wis.
George Wm. H. Long, Indianapolis Ind.
Nina Ervine McLelland Houston, Tex.
Matt H. Miller Edmonton, Alta. Can.
Malcolm E Morse, Rolling Bay Wash.
W Nelson Mercer Ellicott City Md.
W C Nicol Pittsburgh, Pa
W and R Nottingham Utica, N Y
C E. Pearson, Cleveland, Ohio
John LeRoy Prechtl Cleveland, Ohio
L H Poston Arkin, Miss
Royden E Reed Manchester N H.
R Richard Jersey City N J
H M Rose, Huntingdon, Pa.
Forrest M Rouse Providence, R I
Herman J Rowe, Pocomoke City Md.
Mauro G Saenz Mexico City Mex.
A Don Seaman, Muskegon, Mich
Thomas S Short Annagansett N Y
Raymond Shotwell So Tacoma, Wash.
Byron W Sieg Tucson, Ariz.
H T Shrum Oshkosh Wis.
A Wilbert Smith, Los Angeles, Calif.
Albert L Soeteber Mt. Ephraim, N J.
Arthur Stert, Ferndale Mich
Mary A Strickland, Brooklyn, N Y
Paul Sutherland Inspiration, Ariz.
H. M Turner New Haven Conn.
Mrs. H B Walker New Orleans La.
Lynn C Watson, Birmingham Ala.
Max M Weber Sharon, Pa
F Warren Wells Jr Westfield Mass.
Harry Williamson, Whiteville, Tenn.

Second-Prize Winner

Louise Gardiner Walshe, of Jersey City, N. J., winner of the second prize of $100

by three men of wide experience and high standing in the field of mechanics—Prof Collins P. Bliss, Director of the Popular Science Institute of Standards and head of the Department of Mechanical Engineering at New York University; Dr. Hazen G. Tyler, Associate Director of the Popular Science Institute of Standards and Associate Professor in charge of Experimental Engineering, New York University; Alexander Senauke, M. E. E., Radio Engineer of the Popular Science Institute of Standards.

Their selections of the prize-winners in the second of the Monthly Contests, which appeared in the July issue, will be announced in the December issue of POPULAR SCIENCE MONTHLY; winners in the August contest will be announced in the January issue, and the September contest winners in the February issue. Names of winners of the Grand Prizes, totaling $6000, to be awarded for the best solutions to all the 32 pictures appearing in the four Monthly Contests, will be announced by the judges as soon as possible thereafter

From start to finish, our great $10,000 Contest has met with enthusiastic response. Judging from the thousands of letters we have received, we are quite sure that every reader who has followed John and Mary through their vigorous, though sometimes painful, efforts in home-making, has found it profitable and entertaining. We are sure, too, that every reader will join with us, and with John and Mary, in congratulating the 68 winners of cash prizes whose names are announced here.

And, remember, even if you have failed to win one of the prizes in the June contest, don't be discouraged. If you submitted answers also in the July, August, and September Contests, as most of the contestants have, your chance of winning one of the prizes in these contests is just as good as anybody's. In fact, the judges who now are working on the July Contest inform us that a large number of persons who made mistakes in the June Contest have submitted correct answers to all eight pictures in their second attempt. That means, too, that even though you may have had a bad start, you have not lost your chances of winning one of the big Grand Prizes to be awarded for the best answers to all the pictures in all four Monthly Contests.

There still remains $9000 to be awarded—$1000 for winners of the July Contest, $1000 for the August Contest, $1000 for the September Contest, winding up with the $6000 for the Grand Prize Contest.

Third-Prize Winner

Edwin T Brown of Pittsburgh Pa. winner of the third prize of $50 in the June Contest

WATCH for the names of prize-winners in the July "What's Wrong" Contest. They will be published in next month's issue. Names of the August Contest winners will appear in the January issue, and the September Contest winners will be printed in the February issue.

Why a *Thunderstorm* Can *Break* an Airship

As a thunderstorm gathers, swift rising currents of warm air produce a "bumpy" path through the clouds for an airship

How a thundercloud is formed by the merging of small cumulus clouds pushed together by swiftly rising warm currents

IN THE remarkable drawings above, our artist presents a graphic explanation of the effects upon an airship of a severe thunderstorm such as that responsible for the recent wreck of the *Shenandoah*

In the largest picture is shown how a "line squall" is formed by the meeting of uprushing warm air and descending currents that have been cooled by contact with raindrops and ice crystals of the upper atmosphere. Seized by these conflicting currents, a mighty airship is ripped asunder.

The two drawings at the left show how a typical thundercloud is formed by the merging of small cumulus clouds pushed together by swiftly rising currents of warm air. The upper drawing shows as well how the irregular motion of the rising currents makes a "bumpy" path.

The picture in the upper right-hand corner demonstrates why lightning is of little danger to dirigibles. The discharge is carried along the metal framework and passes harmlessly to the ground

Houdini in Disguise

So well known is Houdini that he must assume various odd disguises when exposing the trickery of fake spiritualistic mediums. Here he is in the guise of a deaf old man. In this role he was permitted by a New York medium to talk with the "spirit" of a son he never had

How I Unmask *the* Spirit Fakers

By HOUDINI

WHILE I was playing an engagement in a mid-western city late last spring, a newspaper reporter called on me at the theater

"Houdini," he said, "there's a spiritualistic medium who has been in town for more than 25 years. Would you care to come round with me and look him over?"

Now, telling me that a supposedly genuine medium is in the same town with me is like informing an enthusiastic fisherman that he's near a trout stream For 35 years—during my whole career as a professional magician—I have been studying and investigating so-called psychic phenomena—spiritualism, occultism, clairvoyance, mysticism, telepathy, and similar manifestations of apparently supernatural origin. My investigation has been literally continuous. I never have dropped it for so long as a day. The practice of my profession has taken me to virtually every country on earth, and my travels have enabled me to observe and study the psychics of many lands. And my interest in the subject is more keen, if anything, today than it was when it first engaged my attention

This probably is because my interest in psychic phenomena is personal rather than professional. I have pursued my investigations because I have found them a fascinating kind of scientific research, not merely because seeking to explain the mysteries produced by others may seem to bear some relation to the work of one who is himself a professional mystifier.

ALSO, the really tremendous popular interest in occult phenomena that has sprung up in recent years has stimulated me in pursuing my investigations. Every day that I appear on the stage, hundreds of people in the audience ask me questions regarding spiritualism, telepathy, and kindred subjects. Every day my mail contains hundreds of questions of the

The public wants to know whether there are such things as "spirits," whether it is possible for one man by mere exercise of his will to transfer his thoughts intelligibly to the brain of another man, and so on and so on

And as a servant of the public, which every public performer undoubtedly is, I consider it my duty never to let a chance slip of obtaining authentic data on the subjects regarding which the public is looking constantly to me for information.

So it was with eagerness that I accepted the reporter's suggestion that I accompany him and another man, who proved to be the county prosecutor, out to the medium's home.

Now, despite any impression that may have been created by my activity in exposing fraudulent mediums, in regard to spiritualism I am not a skeptic. Although I have found no genuine physical phenomena medium, by which I mean one who does not produce his effects by purely natural means that any trained magician can duplicate, I have still an open mind. I am willing to be convinced—even to believe, if a medium can demonstrate to me that he actually possesses true psychic power. And when I went to the home of that veteran medium it was with every hope that he actually might prove capable of establishing communication with the spirits of the dead. One who had sustained his reputation for more than a quarter of a century in the same city, I reasoned, well might be assumed to be genuine. Besides, I am far too busy to waste my time "investigating" self styled mediums, who generally are believed to be frauds.

ONCE again, though, I was disappointed. This medium was just another trickster. His "psychic power" was due to his ability as a conjurer. His methods, in short, were merely a crude adaptation of those by which professional magicians mystify audiences from the stage. He was exceedingly clever, but I had unmasked him before his séance was completed, and as a result he was arrested as a fraud

Moreover, after my exposure of this man, the police of the city began a drive against fake spiritualists, which resulted a few weeks later in rounding up 20 of these

Simple but Mystifying

Houdini (at right) demonstrates a simple trick by which the fake medium under cover of darkness, frees one hand to make the spirits perform. After stroking the subject's arms and hands a few times with his finger-tips (above), he deftly removes one hand, placing the other on the backs of the subject's hands in such a way that the change is not noticed. At the left Houdini is seen writing on a slate with his free hand and ringing a small bell that he has placed in his mouth

THE Mystifying Trickeries of Fraudulent Mediums Laid Bare by the King of Magicians in the First of a Great Series of Articles

swindlers who prey upon the credulous, the grief-stricken, and the troubled.

This man was what is called a "trumpet medium." The term probably requires an explanation. A trumpet medium is one who evokes the "spirits" with the aid of trumpets—cones of metal or other material that resemble the fog horns carried by the old-time sailing vessels. The trumpets ordinarily are placed on a table around which the medium and those attending the séance sit in a "circle," each person clasping hands with those on his right and left.

NOW, the medium, being part of the circle, apparently cannot move without those who are holding his hands being aware of it. Yet, as soon as the light in the room is extinguished, queer things begin to happen. You hear "spirit voices," you feel the tapping of "spirit hands" on your head and body; odd, tapping sounds, which you are informed are the sound of "spirit feet," are heard seemingly in the air, or on the walls and ceilings. You hear sweeping sounds, too, which you are told are made by "spirit garments." Sometimes the trumpets, which are distinguishable in the darkness because of luminous rings that are placed upon them, are seen to rise from the table and apparently float about the room.

To one who visits a séance for the first time, these effects are most uncanny. You are quite ready to believe that they actually are caused by "spirits." Certainly, you tell yourself, the medium, with both hands securely held, is unable to get free to talk through the trumpets, raise them in the air, or tap them on the ceiling.

Well, as one who for 35 years has been freeing himself from every sort of bond, encumbrance, and restraint that human ingenuity can devise—handcuffs, ropes, chains, straitjackets, locks, bolts, prison cells, trunks, safes, and packing-cases among them—please permit me to testify that for a medium to free himself from a spiritualistic circle and so get hold of the trumpet is child's play!

And that's exactly how the wonders of the trumpet medium are performed. The medium gets free of the circle—or releases one hand or foot at least—and proceeds to manipulate the trumpets. Sometimes it is a confederate who permits him to escape. Sometimes, as I shall show presently, he does it through his own cleverness. The "spirit voices" that you hear are the medium's voice, disguised, issuing from a trumpet. In the darkness it is virtually impossible to trace to their source the sounds of a faint voice distorted by the megaphonic effect of a trumpet. Try the experiment yourself, and see. The "spirit rappings" and sounds of "spirit wings" are made by the medium's fingers against the side of a trumpet. The taps which the sitters feel are delivered by the medium with a trumpet. To touch the ceiling with a trumpet or to reach a sitter at the far end of the table, the medium lengthens a trumpet by attaching it to another trumpet by means of the mouthpieces, which are made to fit one inside the other.

Where Footwork Summons the "Spirits"

With both hands held securely by his neighbors in the séance "circle," how can a medium get hold of a trumpet and produce mysterious "spirit voices"? One way to do it is by a little clever footwork, says Houdini

Some trumpet mediums also produce "spirit voices" in the daylight. The medium holds the large end of the trumpet near his mouth, and whispers into the instrument without moving his facial muscles, while at the same time carrying on a casual conversation with the sitter. You've seen ventriloquists on the stage disguise the fact that they are speaking by much the same method.

THE particular medium of whom I write performed most of the usual tricks with the trumpets. He also caused a guitar, placed on the table before him along with the trumpets, to be played while he sat with his hands apparently covering those of the persons who sat at his right and his left. He established communication with the "spirit" of the son of one of the sitters, the "spirit" of an Indian chief, who spoke pidgin English in a deep bass voice, and the "spirit"

Amazing Wonders of the Dark Revealed as Simple Child's Play

"For a medium to free himself from a spiritualistic 'circle' and so get hold of the trumpet is child's play." In the circle his right wrist is held by the man at his right, while he grips the wrist of the man at his left. By twitching, jerky movements, as if in the throes of sublime ecstasy, he manages in the dark to transfer his grip from left hand to right, freeing his left hand, with which he picks up the trumpet. The "circle" remains unbroken

of a French opera singer, who led us in singing "Nearer, My God, to Thee."

As I said before, I attended this séance in the hope that the medium might produce something in the way of a genuine spirit manifestation. His methods, though, were so like those of fraud mediums whom I had seen and exposed that I was surprised at having thought him genuine in the beginning, and feared he would turn out to be a trickster. And so, when the opportunity presented itself, I slipped out of the circle in which I sat and smeared lampblack on the trumpets. I waited until the medium had completed his trumpet work, then I rose, drew an electric flashlamp from my pocket, and directed its rays across the table.

IT WAS a startling, though somewhat comical picture that the sudden light disclosed. For there in the circle sat the medium holding the guitar above his head, and his hand and face were as black as a coal heaver's from the lampblack I had used!

By an ingenious trick he had freed his hand to manipulate the trumpets and the guitar.

"You could feel it if I raised my hand, couldn't you?" he had asked one of the sitters beside him, and, as he spoke, he actually raised his hand and did not put it back, but substituted an Indian rest —a stone—of about the size and weight of his hand, covered by a handkerchief as had been his hand. The sitter, feeling the weight of the stone upon his hand, supposed, naturally enough, that the medium's hand had been replaced after its withdrawal. On this trick rested almost entirely that medium's claim to the possession of psychic powers.

Thirty-five years among these vultures has convinced me that they are the most contemptible and the meanest criminals that walk the earth. The confidence man, the burglar, the pickpocket, the highwayman, and others who live by robbing their fellows, must take chances. They meet their victims on even ground and triumph through their wits, their strength, or their courage.

THE fake medium, though, works with everything in his favor. His victims will believe in him. They are grief-stricken by the loss of a loved one, unnerved and troubled by financial reverses, distracted by the disgrace brought upon them by their wayward children. In their search for consolation, in their troubles, for guidance in their difficulties, they grasp at straws. And the medium adroitly worms their secrets out of them, plays upon their fears or their grief, impresses them by elaborate hocus-pocus—trumpet work, slate writing, spirit rapping, table-lifting, spirit photographs and the like—quickly has them in his toils and strips them bare of everything they own.

In the sheltering darkness, which makes it impossible for the sitters to observe anything he does, it is not necessary for the medium to be even a clever conjurer. Tricks that in the light would bring him nothing but a laugh of derision, in the darkness are startling and inexplicable.

I have caught a medium lifting a table —he claimed, of course, that the spirits did it—by squirming upward in his chair until the edge of the table was caught by a hook attached to his belt, while a confederate raised it a corresponding distance on the other side. Can you imagine a stage magician getting away with anything like that? Or can you imagine a stage magician impressing an audience by having his assistant tap certain persons on the shoulders and run his fingers through their hair? Under cover of darkness, though, and masked by the cloak of religion, such ridiculous trumpery becomes most impressive.

"Spirit Faces" of Paint

[illegible] room suddenly shine "faces from the spirit world"—a mystifying wonder. But the wonder is performed, Houdini explains, simply by means of face masks coated with luminous paint and attached to lazy tongs manipulated by a confederate concealed behind a screen. The lower picture shows Houdini examining one of these masks

I remember in Chicago, quite a few years ago, a medium who had gained a big reputation by doing nothing more remarkable than the last thing I mentioned. This medium was a woman. She insisted upon being firmly held during her séances. Yet as soon as the room was made dark, the sitters felt taps on their shoulders and other parts of their bodies. Fingers were run through their hair. Their watches were snatched from their pockets and thrown to the floor.

I attended one of this woman's séances and I was completely mystified. She seemed to have no accomplices. I knew she had not left her seat during her manifestations, for I myself was holding her. However, my experience and my common sense both told me that her work must be accomplished by some natural means, so the second time I visited her spiritualistic chambers I went prepared. As soon as the light was extinguished I poured a bottle of indelible ink over my hair. In a few moments, as I expected, there came a light touch on my head. I moved my head so as to encourage the caresses, and the "spirit" spent quite a little time in pulling my hair and disarranging it.

AND then, when the light went up, the secret of these mystifying manifestations was plainly disclosed, for the hands of a little old woman who sat in a far corner of the room—by far the most innocent appearing person present—were black with ink!

One thing that has impressed me with regard to almost all mediums that I have seen and investigated is their startling lack of originality. The methods that mediums use to impress and mystify dupes today differ in few essential particulars from the methods that were used by the first mediums who sprang up like mushrooms after 1849 in the wake of the famous Fox sisters.

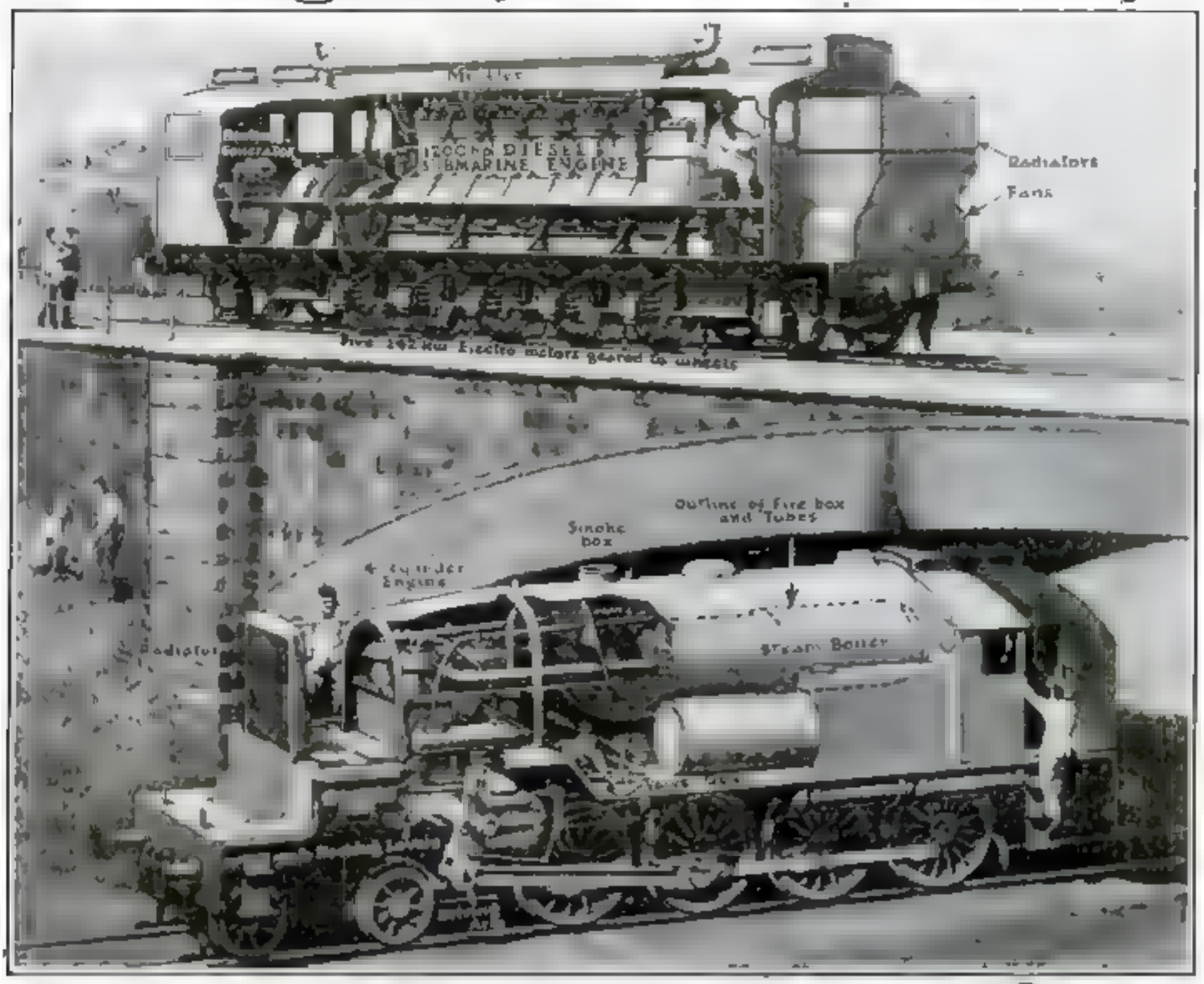
THE Fox sisters, Margaret and Katie, were the founders of spiritualism as we know it today. They were two mischievous children of eight and six respectively, who lived on a farm at Hydesville, N. Y. To frighten their mother they began dropping apples and making other similar noises on the floor of their bedroom while they feigned sleep. Later they learned to produce the sound of rapping by clever manipulation of their fingers and toes, and in a short time the superstitious country folk imputed supernatural powers to them.

An older married sister saw commercial possibilities in the odd accomplishments of the children, and exploited them widely. That was the beginning of spiritualism, and, although Margaret Fox made a full confession in 1888, explaining in detail how she and her sister had fooled the public for years, spiritualism has continued to endure, and the number of mediums has increased steadily.

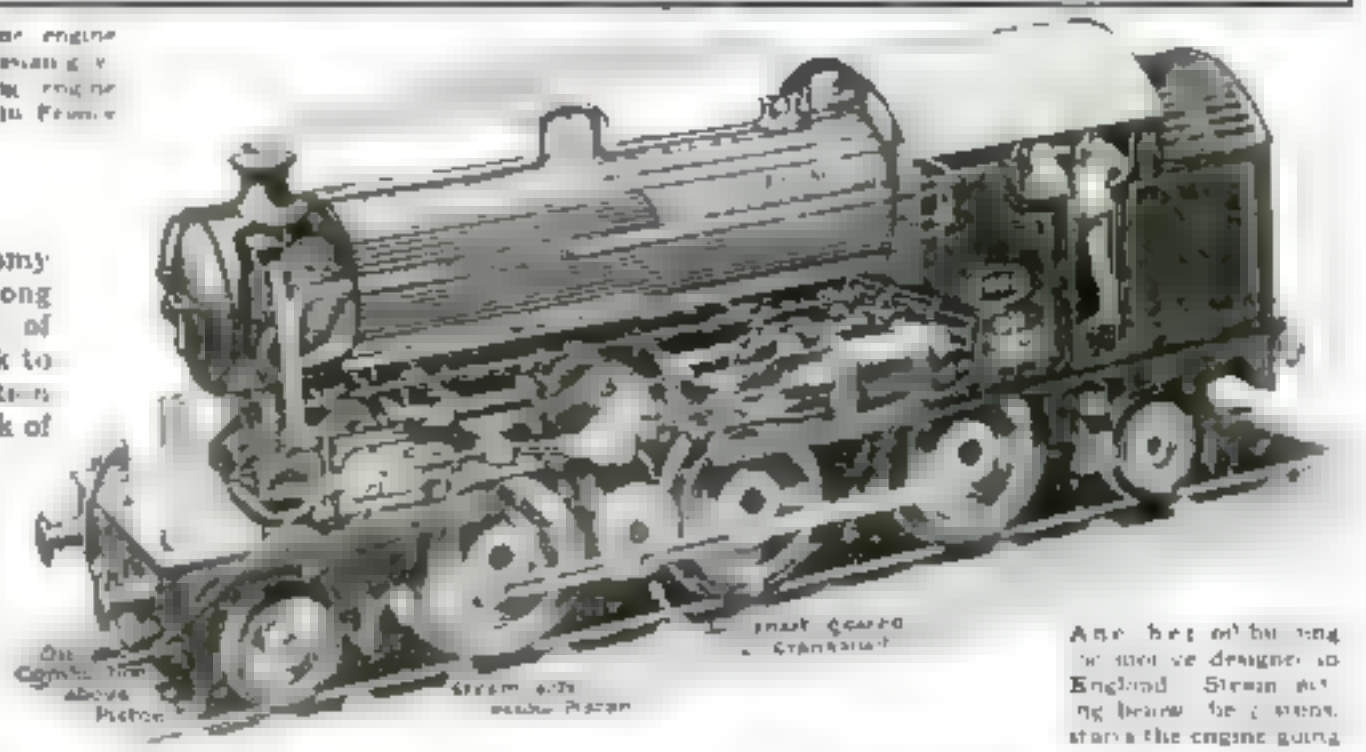
Another point that I have noted with regard to mediums, a circumstance that should give any thinking person pause before accepting as genuine the manifestations he witnesses, is that no "spirit" materialized by a medium ever offers anything that is above the mental level of the medium. All spirits, that is, talk in character with the medium.

(Continued on page 158)

New Engines *for* Motor Railways



Above: Locomotive with Diesel submarine engine and electric transmission, built for the Russian government. Below: The latest oil-burning engine with steam auxiliary which was designed in France



By S. W. Clatworthy

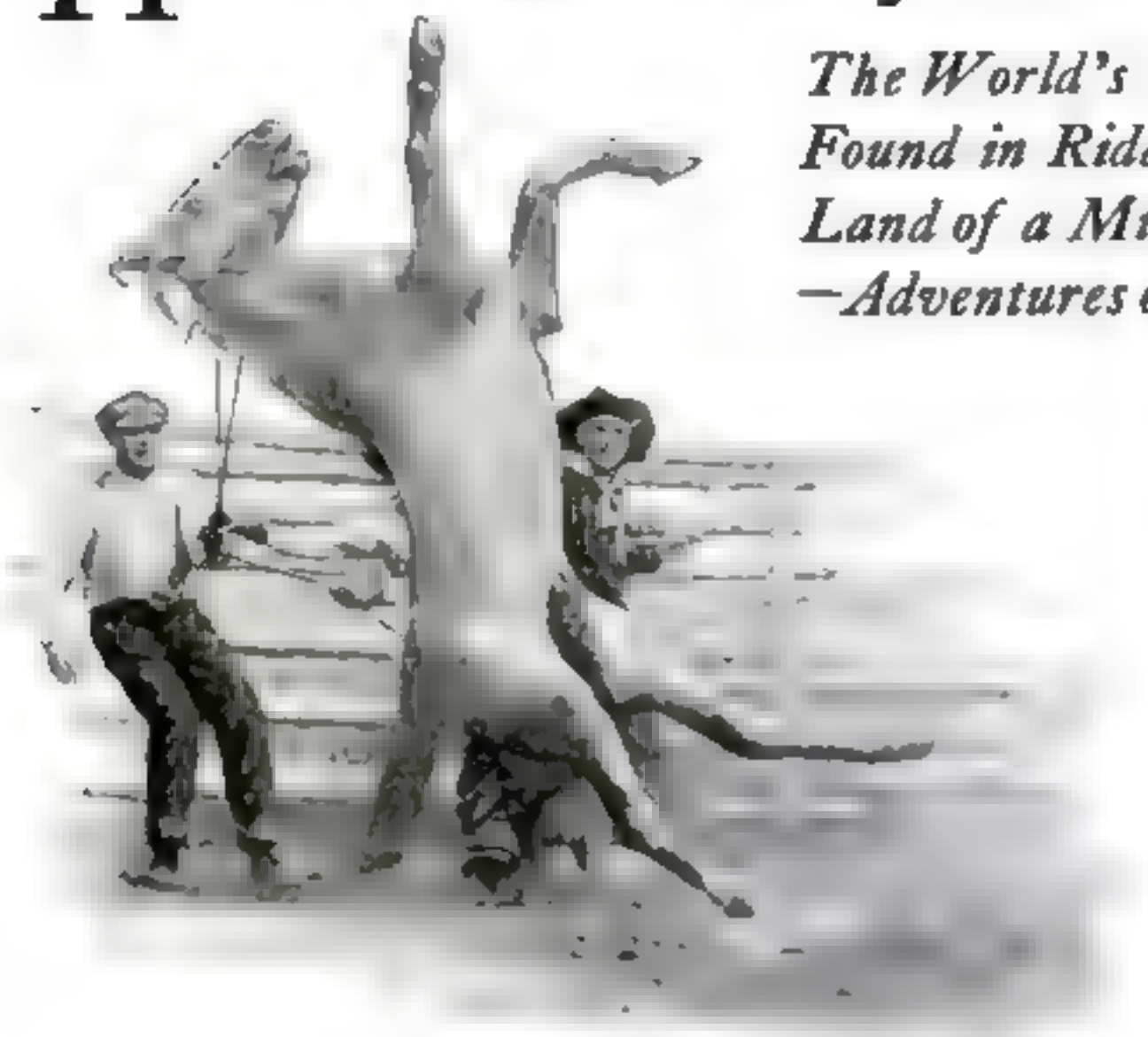
WHILE the efficiency and economy of the motor-ship at sea long has suggested the advantage of motor-locomotives, the chief drawback to practical use of the internal-combustion engine on our railways has been its lack of flexibility. In other words, because it is essentially a one-speed engine, it is found incapable of widely varying output of power to meet changing demands. Though remarkably economical on ordinary stretches of road, the motor-locomotive cannot start a heavy train unassisted or climb a steep incline.

Three of the most recent attempts to remedy this difficulty by auxiliary steam or electrical transmission are pictured here. The locomotive shown at the top has just been completed for the Russian government at the Hohenzollern Works in Germany. It employs electrical transmission, with five driving motors, placed one in front of each pair of wheels. A 1200-horsepower Diesel submarine engine forms the main power plant. The radiators are adequate only in cold weather. In warm weather a cooling tender must be added. While electrical transmission is found to involve a loss of 30 per cent in efficiency, this machine is said to be remarkably easy to control.

The other two locomotives both use steam as the auxiliary, the center one being designed in France and the lower one in England. In each case steam, acting below the pistons in the cylinders, starts the locomotive. After the necessary speed has been reached, the steam is used in combination with oil.

How a Cowboy-Aviator Hunts

The World's Most Thrilling Sport Found in Ridding Western Grazing Land of a Million Outlaw Animals —Adventures of a Famous Buckaroo



Breaking a Wild Captive—A Desperate Struggle

Imprisoned in the corral, roped, and bridled, the magnificent outlaw fights desperately, flinging his white body high in the air in an effort to shake off his captors. A typical "bronco-busting" scene on the Montana range, where a campaign is on to exterminate wild horses

THE great white stallion snorted, wild-eyed, muscles tensed, his gorgeous mane tossing in the breeze that swept across the vast desert of the Colorado Plateau. Behind their leader a shaggy band of mustangs trembled in terror.

Out of the mighty depths of the Grand Canyon rose a humming roar that thundered through the spacious silence of the plateau as a great winged creature shot from the chasm at the North Rim and swooped downward, like a giant bird of prey.

With a scream of warning the big stallion lunged forward, a flashing streak of white, while the pack of wild mustangs pounded the desert at his heels. Madly they tore across the waste of sagebrush and cactus in a terrified race to shake off the strange menace from the skies.

The pursuer swung lower. Closer and closer it flew, until its great wings cast a shadow over the tossing, straining herd, and its roar drowned out the beat of flying hoofs. Mile after mile the relentless pursuit continued. Now a raw-boned mare at the rear of the band faltered, stumbled, and fell. Now a spotted colt wavered and lagged behind, all a-tremble. The terrific pace was beginning to tell.

Suddenly the leader reared his white body high, wheeled about, and as suddenly doubled back toward the canyon rim, the other horses following. But the pursuer was not to be shaken off so easily. With banked wings it cut a sharp circle in the air, and once more the race was on. Reaching the rim the horses turned again, only to find that their cannibal efforts to escape were in vain.

And when at last the enemy soared away into the higher reaches of the desert air, it left behind a sweating band of exhausted, trembling broncbos—easy prey to the unerring lariats of cowboys.

So ended the most spectacular wild-horse hunt since the days when the Indians and Mormon pioneers in the Colorado Plateau country began rounding up the untamed descendants of the Arabian mounts of the Spanish conquistadors. A most dramatic and thrilling race it was, for in it were matched all the cunning and speed of unbridled horseflesh against the marvel of modern science—the airplane.

The pursuing pilot in this first attempt to hunt wild horses by airplane was none other than "Chance" Parry, one of the most famous wild-horse hunters of the West, and at the same time one of the most daring of aviators. The new manner of hunting was his idea. From his long experience on the plains he knew that the speediest horses that could be mustered for pursuit would have been shaken off quickly by this fleet wild band. What he did was to prove that the airplane, swooping so low that he could plainly see the tossing manes and the rolling eyes of the frightened herd, was not to be outdistanced.

So successful was his novel experiment that Chance recently launched a plan of campaign that promises to be a spectacular feature of the West's general movement to capture the untamed broncbos that now roam the plains in such numbers they are looked upon as a menace to the cattle and sheep grazing industry. That the wild horses really are a menace is evidenced in Utah, for example, where several seasons of drought have brought trouble for the sheepman, for it has been difficult to find sufficient grazing on winter range. With thousands of wild horses feeding in unrestricted freedom, the grazing has been cut down.

TODAY sheepmen lie in wait for the wild steeds at the water holes. Indeed, it is not uncommon to count as many as 50 dead horses beside a water hole—slaughtered by sheepmen to protect the range. In Montana it is estimated that 400,000 wild horses are running at large, while the number in Utah, Nevada, and Arizona probably will swell the grand total to more than a million. The range grass consumed by the wild herds in Montana alone, it is figured, would support 2,000,000 sheep or 800,000 head of cattle.

A fine herd of wild horses, trapped at a water hole, a menace to cattle and sheep grazing. In the

Wild Horses

By

ARTHUR CHAPMAN

Mr. Chapman is a noted writer of Western stories and verse. He is best known to the American public for his celebrated poem, "Out Where the West Begins"

Roped!—An Impromptu Wild West Show

In the branding corral the wild horses to be broken are roped and hog-tied. At the end of the rope the outlaw begins a terrified struggle which continues even after he is brought to the ground. At the left is Chance Parry famous Western cowboy and aviator, the first man to hop with horses by airplane

Chance Parry's plan of campaign is to locate wild-horse bands and to follow them by airplane, holding relays of horsemen in readiness to take up the pursuit when the broncbos have become so exhausted by the chase, they can be captured easily by the cowboys. In all the West there probably is no other man so well fitted to carry out this new method of hunting. Wherever the subject of wild horses is mentioned in the Southwest, the name of Chance Parry inevitably figures. His full name is Chauncey G. Parry, but he is well nicknamed, for the chances he has taken in saddle and airplane have brought him fame, even in a frontier land.

PARRY is a typical product of southern Utah, where the hardy Mormon pioneers learned their lesson of sturdiness and self reliance in the wildest, roughest school in the world. Even in a country where all children learn to ride as soon as they can sit upright, Chance's feats of horsemanship as a boy became a matter of comment. The wild horses that he saw roving about the Utah ranges fascinated him. When he was only 10 years old he began to take part in the wild-horse hunts. And when he was at the age when most boys dream of acquiring a steady-going Shetland pony, Chance was out on wild-horse hunts of his own, riding bareback and matching the speed of the best horses on his father's ranch against the fleetness of these flitting equine shadows of the plains.

Parry now is in his thirties—a typical keen-eyed, hard-sinewed Westerner of the outdoors. He has hunted all kinds of game in the depths of the great Kaibab forest, and has brought down cougars in the side canyons that lead toward the appalling chasm of the Grand Canyon. He has served with the U. S. Army Air Service in the World War. But hunting wild horses, he says, has brought him the greatest thrill of all.

"It's the greatest sport in the world," he told me, recalling some of his exciting experiences. "The wild horse is not only the swiftest, but the cleverest of animals. The 'sportiest' way of hunting wild horses is to run them down in the open. In the past this has been done only by relays of riders. It is often very dangerous, but there's nothing like it for pure thrill. The only way to do it is to ride bareback, for this not only relieves your horse of the weight of the saddle, but often saves you from injury in case of a fall. Such hunting can be done successfully only in relays, for no saddle animal, with a man on his back, can hope to get within gunshot distance of a wild horse."

THE wild horse of the Western plains has a proud lineage, though in many cases inbreeding and crossing with inferior blood have worked havoc with his appearance. Generally speaking, he is a descendant of the first Arabian horses brought to this country by Coronado and other Spanish explorers to assist in conquering the Indian tribes of Mexico and our own Southwest.

Pedro Escalante was the first of the Spaniards to take horses north of the Grand Canyon when, in 1776, he set out to find a route from Santa Fé to the missions of California. In the course of his wanderings he penetrated what is now northwestern New Mexico, western Colorado, and southern Utah, and in these regions he left many of his fine Arabian steeds, some being lost, and others being driven off by unfriendly Indians. These horses formed the nucleus of the wild herds now roaming the Colorado Plateau region, including northern Arizona, Utah, and Nevada. Plains Indians from the North came down and captured horses from the Navajos, Paiutes and other south-

(Continued on page 165)

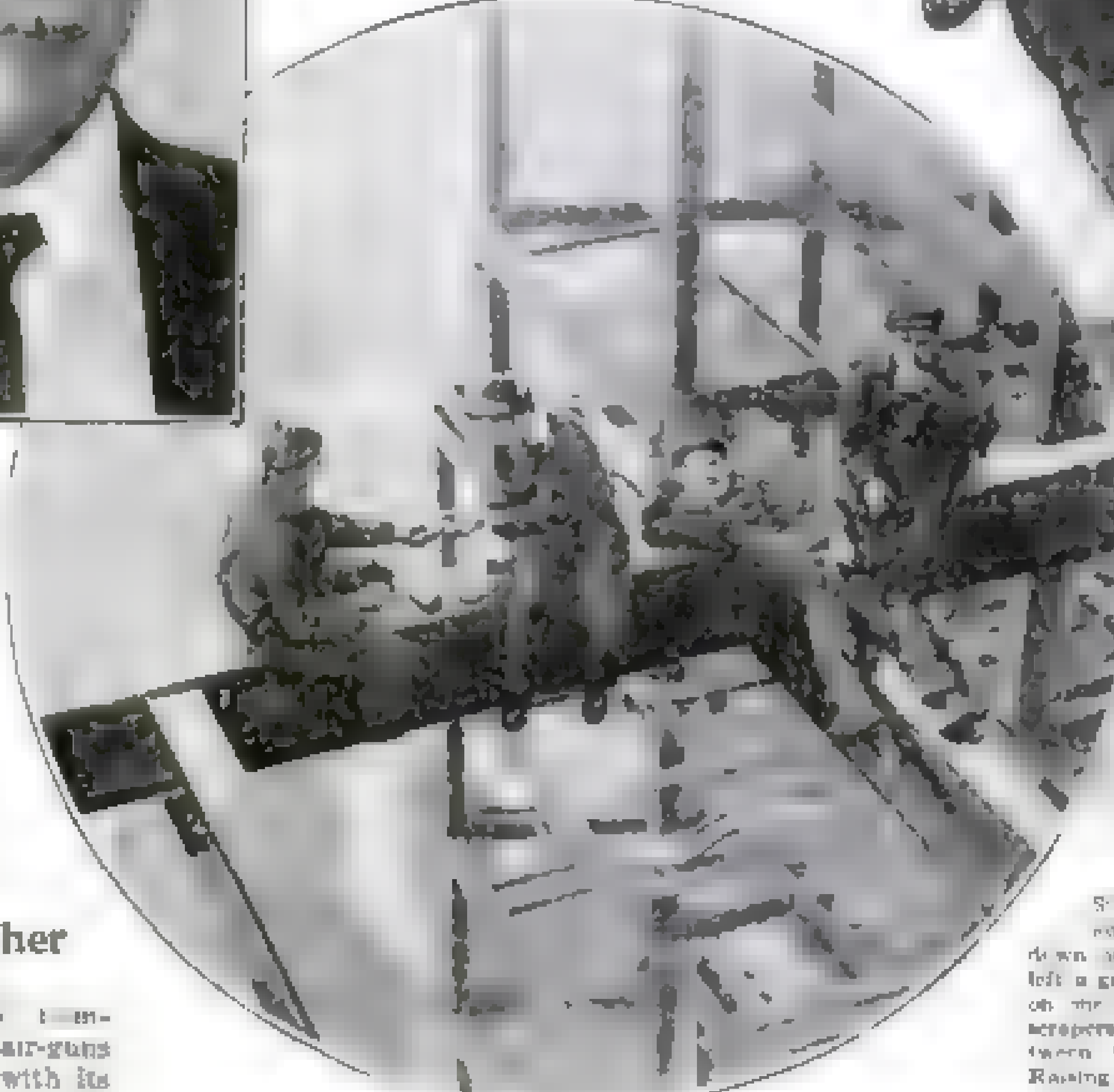
hole. Nearly a million of these animals roam the Western plains in bands of from six to 30 or campaign to capture them, "Chance" Parry proposes to run them down by low-flying airplanes

Every Day's Work a Gamble with Death

The Veteran

For about a half century Adam Diehl has been [illegible]. He ran away from home to become a [illegible] of fiery rivets, and was a foreman at 23. Now a [illegible] more than 70 years old, he is still on the job. In the accompanying article he explains the work of the men who fashion our huge skyscrapers

Daring Adventures of Strong Men Who Fashion the Steel in Our Skyscrapers



"Just Joy Riding"

Steelworkers are as comfortable 'way up there as we are down here. They [illegible]. At the left a group is eating lunch high up on one of New York's newest skyscrapers, with only a steel beam between them and death. Above: Raising a finger of steel to the sky, a job that takes a very strong man

By Peter Vischer

A THUNDEROUS bombardment of air-guns assailed my ears with its deafening roar. Here and there on the gaunt metal network that stretched from beneath the sidewalk to 20-odd stories over my head, nimble, sure-footed pygmies scurried about or hung perilously from the edges of the frame. They were piloting huge steel girders into place, snatching red-hot rivets tossed to them apparently from nowhere, and driving them home with head-splitting clatter, hauling with fierce strength on the giant wrenches that locked the massive beams, roaring their hoarse directions to the hoist runners.

The great skeleton of New York's newest skyscraper was rising bone by bone from a huge pit in the crowded street. All was noise, bustle; seemingly confusion, too. The effect was stirring and impressive—even, I must admit, a bit terrifying.

Adam Diehl, veteran boss of steel jobs, a grizzled, raw-boned giant who is now past 70 and has been handling iron and steel for half a century, stretched out a long arm in a gesture that included the whole scene.

"Those boys up there," he said with a wink, while a quizzical smile illuminated his weather-beaten face, "they're just joy-riding. It may give you a thrill, son, to watch 'em running around up there like so many monkeys. To them, though, working aloft is just a joy-ride. Our big work—our hard work—we do where nobody sees us—down in the ground where we have to handle heavy tonnage in water, dirt, and loose rock while we set a foundation. That's *real* work. Once we're above the street, though, it's a romp—and I don't care if you go as high as the Woolworth Building, or higher

"Not," he made haste to say, "that hopping round above the steeples, with nothing but a six-inch steel beam between you and an introduction to the angels, isn't dangerous. It is. There's only one other thing a man can do that's worse; and that's handle dynamite. But most folks have an idea of our work that's just exactly wrong. The higher the building, they figure, the harder the work. But it's not so. Height we don't mind at all. We're as comfortable 'way up there as we are down here. Steel-workers have level heads. Otherwise, instead of being steel-workers they'd be selling fish, or something. They're never afraid. They're squirrels, that's what—quick with their hands, and their feet, and their minds. They don't get rattled. When they do fall, you can bet it's because something hit them and knocked them off. Yes," he repeated with a reflective nod, "it's a joy-ride—that's all."

IT TAKES gruff men to find so blunt a summary for the spectacular circus of structural steelwork; raising a finger of steel to reach for the sky. But that's just what Adam Diehl and the other "boys" of his trade are—tough and hardy as the grim metal from which they shape the towering structures that make our modern cities, and the great bridge spans

over which speed our railroad trains and our motor-cars.

And these men, into whose bodies, into whose very souls has been fused some of the hardness and strength of the metal with which they work—they more, possibly, than the exponents of any other single trade or calling, carry forward the progress of civilization. For the story of our modern civilization and the story of iron and steel are one. Man's progress dates from the day, 6000 years ago, when he first learned to make iron in his crude, tiny smelter. Each milestone in his climb to his world of today is marked by the discovery of some new use for iron or steel. And the men who fit modern steel into our great buildings and bridges are in every sense worthy of the importance that steel has held in shaping the world's history.

THEY have true courage, fine skill, and the love for their craft that is the mark of the real artisan. They, with their splendid contempt for hazards that would cause a less hardy breed to quail, may style the more spectacular phases of their work a "joy-ride," but in their heart of hearts they know they skirt widely round the truth when they speak so. For structural steel-working, below ground or above, is no pleasure jaunt, but a thrilling, soul-trying man's calling, crammed to the brim with romance, with adventure, with conflict, and with dangers that make heroic deeds merely part of the day's work

A few weeks ago announcement was made that construction will begin soon on the largest office building in the world in New York City, north of Grand Central Station. It is to be seven stories in the rock and 50 above the street. Construction is to cost $19,000,000 and the building is to have 1,350,000 square feet of floor space, more than the great General Motors Building in Detroit, more than the Equitable Building in New York, the world's two largest buildings at present.

Huge columns of steel will be set down beside Grand Central, each one numbered, drilled with holes, all ready to be stood up and riveted together into the framework of a new marvel of engineering.

Sounds very simple, doesn't it? Quite like the joy-ride that old Adam Diehl described. But wait!

All of those columns—and some of them weigh 60 tons apiece—will have to be hauled past the third rail of the New York Central tracks. Let one of them drop—a short circuit! High voltages transferred in a wink from the power rail to the mighty shaft of conductive steel! Sixty tons made suddenly alive with death-dealing current! A joy-ride, that? Scarcely. Nor am I suggesting merely a terrifying possibility. For that identical thing happened in those same Grand Central yards not long ago during the construction of a new apartment building on Park Avenue. No one was killed that time. Of the next time, though, who can say?

Compared with such a job, erecting the upper stories of New York's newly projected 65-story hotel, eight feet taller than even so mighty a structure as the Woolworth Building, is child's play, once the foundation is laid. For this and other famous skyscrapers are in their upper stories what the structural steel erector calls "typical"—square, clean-cut work of a kind that the "boys" have performed time and time again. When they get away from the typical, though, their work becomes difficult and dangerous

THUS, Adam Diehl, telling me of the thrilling experiences he has had in more than a half-century of steel and iron-work, shook his head grimly when he mentioned a comparatively insignificant structure—the electric tower erected for the Pan-American Exposition of 1901 in Buffalo, N. Y.

"There was one," said Diehl emphatically, "that was a beaut! Narrow, a temporary building, and so mechanically delicate, 475 feet high, and it had to be put up while the wind from Lake Erie blew in on us in gales. I'll tell you the boys had to hold on to that one with their teeth! There were 65,000 turned bolts in it, and we had to rivet in every blessed one of them by hand

"WELL, we got it up without losing a man. Then, after the exposition closed, they decided to take it down again and put it on top of a building in St Louis. That meant cutting out those 65,000 bolts, and taking the pieces down in such shape that they could be set together again. We got off to a good start, and got most of it down. Then one day the wind got to blowing a little harder than usual, and a section collapsed. One of the boys tumbled down in it. He didn't have a chance for his life. Three others, who got caught in the wreckage, were badly banged up, but managed to pull through

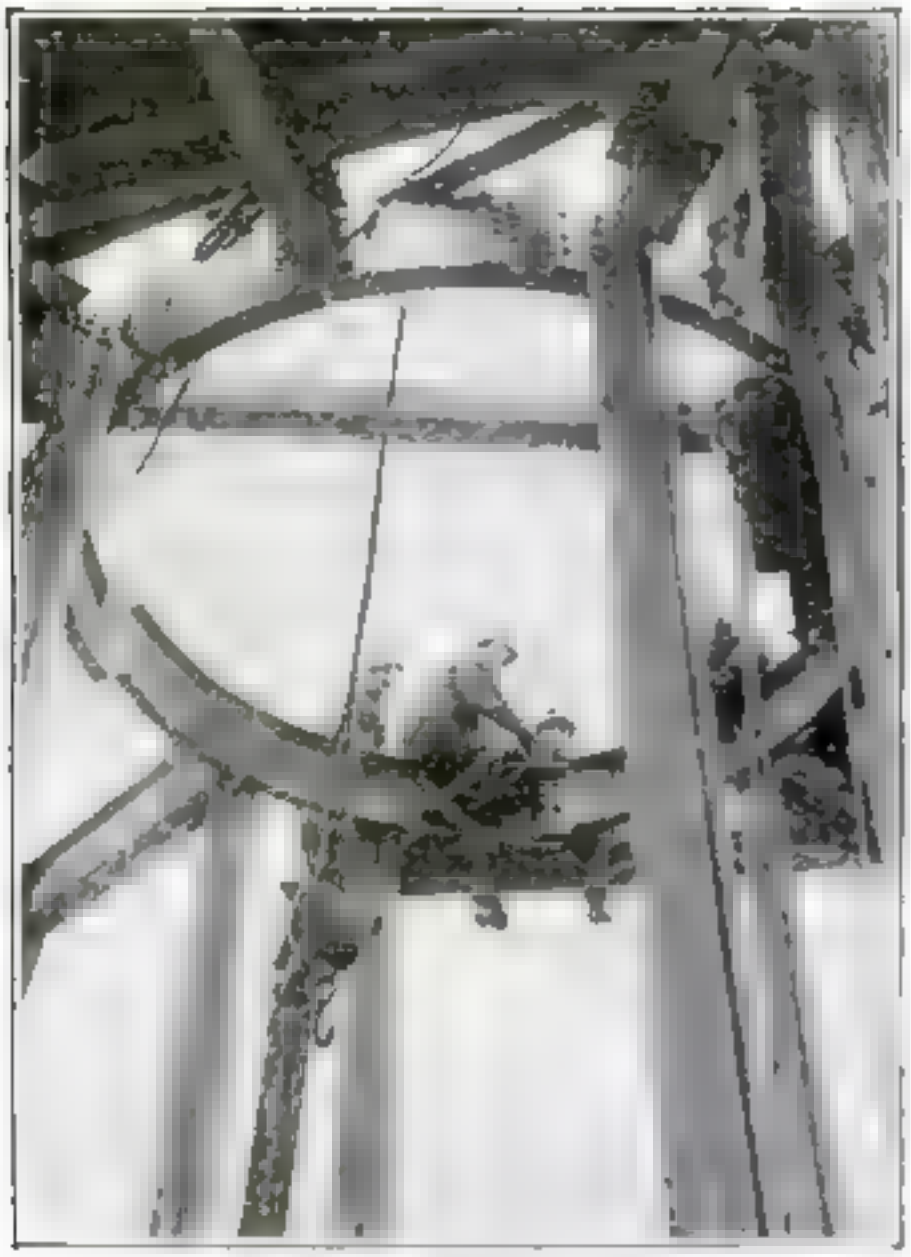
"And that wasn't the worst accident I ever saw, by any means. I got an early look at one. When I was a young fellow, breaking in, I got a job on some of

Giving the Crowds a Thrill

Occasionally the structural steel-worker relieves the monotony by giving the crowds below a real thrill. Such "stunts" as this young giant is performing, however usually are discountenanced because of their hazards. Most of the structural steel-workers wandered to the jobs as boys, lured by its romance its danger, and its many exciting adventures

Spectacular as a Circus

In building and repairing our great bridges, such men as those at the left perform feats that would make any circus performer gasp. For them it is all in the regular day's work



As Quick and Nimble as Squirrels

"The builders of our towering skyscrapers and great bridges are like squirrels—quick with their hands, their feet, and their minds. They don't get rattled. When they do fall, you can bet it's because something hit them and knocked them off, or because of bad weather"

the Centennial buildings in Philadelphia, back in 1875. I was doing all sorts of odd jobs, learning the business. Now, Machinery Hall and the main exhibition hall had iron in them and they were going up without any trouble. But right next to them another building was going up in wood and bricks.

"There were a lot of men on that job, all busy with their own worries. One day when the weather was bad, all of a sudden we heard a crunching and a grating and then there was the brick and wood all tumbling together. Men on scaffolds were falling in with the mess, yelling and hollering so you could hear them for miles. I can hear them yet, and I'll tell you I'll never forget it. The wind had just spilled that thing together and we had to unscramble it to get out the poor devils caught in it. Eighty-eight we found, and we laid them out on flat cars and along the street. That was a dismal start for a young fellow, I'll tell you.

"SINCE then I've seen fellows go down time and time again. And still, when you consider the kind of work the boys do, the casualties aren't so heavy. Eight out of ten of the boys are six-footers and over and can take care of themselves. And if you don't believe that, you ought to see them fight. A good many of us live to a fine old age."

Diehl has worked on all kinds of steel construction. He was born in Philadelphia and ran away from home because he didn't like to go to school. He got odd jobs on construction projects and soon became a favorite with the "pushers," as the foremen are known, because he was strong, active, and energetic, and because he could toss fiery rivets like a champion.

"I GOT into this," he says, "because like most young boys I imagine I was strong in the back and weak in the head. However, I got along. The competition was stiff enough, because in those days you stayed down unless you could lick every man in the gang. But I was a foreman at 25."

In time, Diehl became a structural steel-worker, or bridgeman, and then began a nomadic existence that has taken him to several continents, working on all kinds of construction projects — buildings, bridges, subways, elevated railways, and ships. He is one of the best known men in the steel industry, and well he might be, for he's been at it since before there was steel, since the days when wrought iron had to be used. The whole steel industry knows Adam Diehl, and loves him.

Diehl's introduction to the steel business was rather typical. Most of the men in it wandered to it as boys. First they were ordinary roustabout boys, apprentices, doing odd jobs around and helping the iron-workers with their tools. Naturally, they were ambitious and their great ambition was to take the next step and become what is known as "rivet boys."

Now, many a youth would enjoy being a rivet boy. He is that spectacular young devil who tosses red-hot rivets from a fire to another of his gang who nonchalantly catches them in a pail some yards away. Here's a true expert's job, for a rivet tossed up around the thirtieth or fortieth story can do considerable damage before it lands hundreds of feet below. Because the job is so exciting, it catches the eyes of young apprentices, and they spend many hours practising tossing and catching rivets.

Eventually apprentices become full-fledged bridgemen or structural steel-workers. Nowadays, in such cities as New York, Jersey City, Newark, Paterson, Atlanta, and Cincinnati, this means $12 a day for an eight-hour day, with double pay for overtime. (Rivet boys, if they're good, get eight dollars a day, which shows the esteem in which they are held in the steel industry.) Bridgemen do all kinds of work, from setting foundations a hundred feet below ground to making connections of steel beams hundreds of feet in the air.

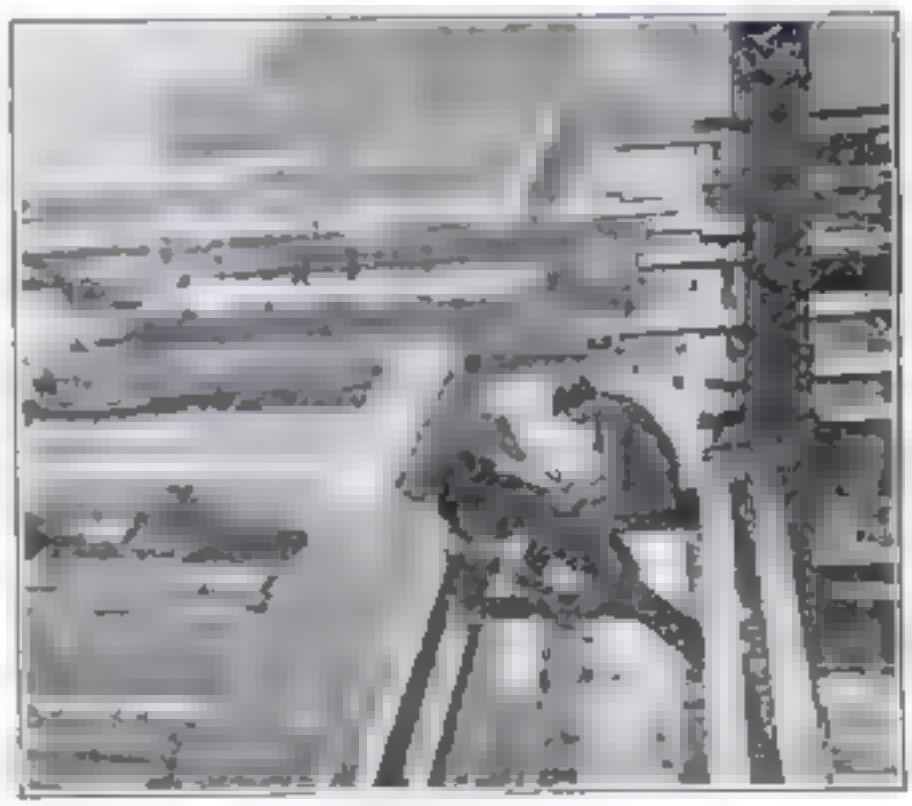
In time, bridgemen may become "pushers" or foremen, when they earn as much as $100 a week, sometimes a little less, sometimes a little more. But at heart they're always bridgemen.

"Bridges are the best," says Diehl. "You work on a bridge and all is happy. You don't have to argue with concrete men or carpenters, or with cops, architects, superintendents, owners, inspectors, or anybody else.

"Sometimes, of course, bridges are no cinch. I remember once when I had just gone on vacation. I had had one day and three hours off when I got a hurry call to hop out to Ohio. I got to Zanesville and found the place under water. It was the time of the Dayton flood. Thousands of people were marooned, their homes wrecked. They were without shelter and were starving. They had no way of escape, for there was just one bridge left from Coshocton to Wheeling. Funny thing, too, that one surviving bridge was cement, cracked at that; and condemned to destruction.

"YOU can bet they needed bridgemen, and they called them from places all the way from Frisco to Halifax. From all over the country they came to Zanesville to try and get trains and food and medicines and shelter out to women and kids who were going all to pieces from fear and hunger and exhaustion.

"There was real work done there. We didn't have any decent tools and we didn't have steel. We managed to get



Perched High above New York's Waterfront

There is a thrilling, soul-trying calling that demands level heads and courage. Only one job is more dangerous—handling dynamite

The Strangest Ship Afloat

The "Carnegie" Has Sailed 300,000 Miles to Make the Oceans Safe for Mariners

By Hawthorne Daniel

World Mariners of Science

Above, at right, Dr. Louis A. Bauer head of the magnetic survey is shown observing magnetic declination with a correcting compass. Captain J. P. Ault master of the *Carnegie*, stands beside him. Picture at left shows the *Carnegie* at Mauritius Island, Africa. This remarkable wooden brigantine has practically no iron nor steel in her. She is fastened together with treenails, bronze, and copper

Ashore at Iceland

Taking observations with a marine correcting compass at Eagey, Iceland. Measurements of compass variations made by the *Carnegie* have saved many wrecks

TIED at her pier in Washington, D. C., is the strangest ship in the world. At present she is laid up, with her decks hidden beneath a tentlike structure that covers her from bow to stern. But within a few weeks she will set out on the latest of a series of cruises around the world, engaged in one of the most unique missions on the seas.

The ship is the *Carnegie*, a 155-foot brigantine, owned by the Carnegie Institution of Washington and operated by the Institution's Department of Terrestrial Magnetism. Her task is to voyage all over the navigable waters to make a magnetic survey of the oceans, to cruise in search of the mysterious magnetic and electrical phenomena that appear to occupy all space, that attract the needle of compasses, that cause the brilliant displays of the aurora borealis, that produce the radio bugbear—static—, and that assist inbalking the waves sent out by radio stations.

In her 16 years of voyaging she has passed through many thrilling adventures. She has been within 600 miles of the North Pole, and is the only ship that ever circumnavigated the South Polar regions in a single season. The whole nautical world is indebted to the scientists on this little wooden ship, which already has sailed 300,000 miles.

THE *Carnegie* is like no other ship ever built because she is put together with practically no iron nor steel in her. It was extremely important that a ship investigating the world's magnetism carry nothing to deflect the instruments

Learning Secrets of the Air

One of the remarkable instruments used aboard the *Carnegie* to determine electrical variations in the atmosphere above the sea a study of increasing practical value to radio communication over land and sea

She is made of wood fastened with locust treenails, copper, and bronze. All rigging is of hemp, anchors are of bronze, and she has no anchor chains, using instead great manila hawsers 11 inches in circumference. The chairs on board are put together with bronze fastenings. The cook uses aluminum and copper kettles. If the sailors carry pocket-knives aboard, they must throw them overboard before sailing. Every bit of metal must be tested carefully with a magnetic needle before it is allowed on board.

While the *Carnegie* is a sailing vessel, she carries an auxiliary motor and in this, steel could not be eliminated entirely. The specially built engine is made of brass, bronze, and copper, but the pistons and cams are of steel.

AS THE ship wanders from North to South Pole, the scientists on board determine the variation of the compass. This information, used in charts prepared by the United States Hydrographic Office, in collaboration with the British Admiralty and the French, Japanese, and German governments, has saved hundreds of sailors from shipwreck.

Compasses, as generally is known, rarely point exactly to the north. Because the earth's magnetic poles are approximately 1200 miles from their respective true or geographical poles, compasses may point in any direction, depending upon where they are used. The difference between true north and the direction indicated by the north end of a compass needle, is known as the "variation of the compass." This always must be determined by a navigator to find his real position. The calculation is complicated, because the magnetic poles and the magnetic lines of force connecting them are shifting constantly and not in a regular manner

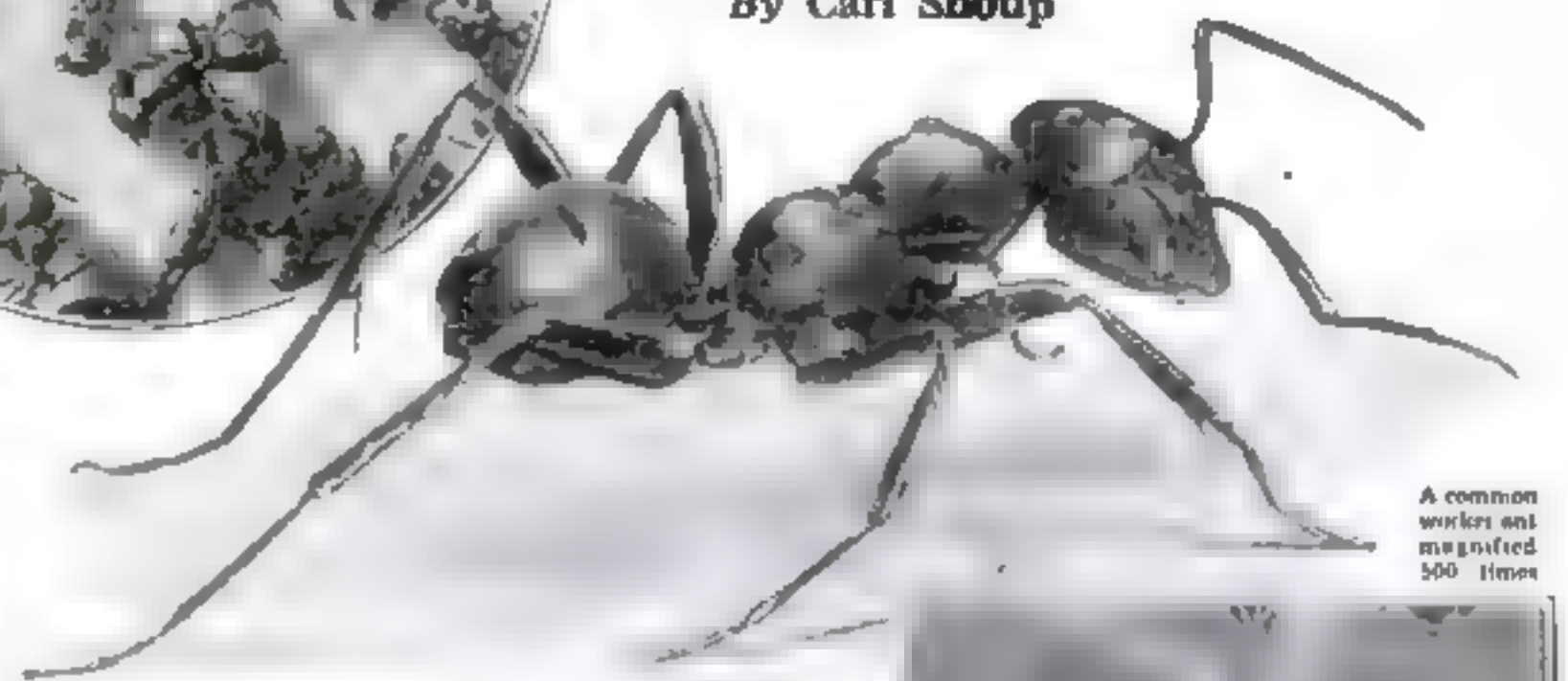
In the cruise that now is planned, the *Carnegie* will cross many hitherto unstudied regions, check up on earlier data, and gather new information about the electrical phenomena of the oceans.

Ant Legions *Fight* Savage Battle in a Zoo

By Carl Shoup

After the Battle

This remarkable photograph shows the mangled remains of warriors slaughtered in the terrific and ruthless battle between two tribes of ants recently in the London Zoo. Several hundred were killed and many others badly wounded



A common worker ant magnified 500 times

A Herd of "Cows" on the Dairy Farm

Carpenter ants tending their "cows"—the aphids of plant lice—from which the ants learned to obtain sweet "milk" by stroking them with their antennae

THEY staged a battle over in the London Zoo recently. The keepers turned a thousand or more animals loose, urged them to attack each other, and before the mêlée was over, several hundred had been killed and many others badly wounded. The London newspapers carried running accounts of the fight; excited spectators came to view it.

Why was such a thing allowed? Well, you see, all the "animals" were ants. That made it pretty safe for the human onlookers. But if you think that the battle was any less ferocious or deadly than a combat between tribes of wildcats or herds of elephants, you are mistaken. The ant, when properly aroused, can give any animal lessons in ruthlessness.

The most remarkable thing, however, was the way in which the opposing armies planned their campaigns and conducted their attacks. It was proof of that illuminating remark made by the great English naturalist, Sir John Lubbock, when he said, "Of all animals, the ant is nearest to man in all his actions." The remarkable intelligence of the ant, which makes him one of the most versatile creatures alive, has long aroused wonder, and here is a demonstration that he can use his brains in the heat of battle as well as in the calmer days of peace.

IT ALL started on a bright Monday morning, when one of the keepers at the Zoo placed a little wooden chip, not on an ant's shoulder, but over the moat that separated two ant colonies—an old one that had been there for three years, and a new one just arrived. The chip served as a bridge, and for the first time made possible communication between the two nests.

A member of the old colony got curious. He sneaked across the bridge and penetrated into the new nest of ants. He never came back

That meant war, the old ants decided. But they did not lose their heads and dash pell-mell across the bridge, only to be swallowed up in a possible ambush. Instead, they chose 10 of their best warriors and sent them out as scouts. These daring ants crawled across the chip of wood, with the muddy water of the moat menacing them from below, and crept cautiously into the enemy's territory.

THEY found nothing. All the new ants were hidden away in their nest, unaware of the catastrophe impending. The wise scouts went back home.

An excited council of war must have followed, for in a few minutes there issued from the old nest an imposing array of warriors, marching in ranks as orderly and well defined as the Macedonian phalanx. A few scattered ants running alongside threw the white sand up into little mounds that could serve as fortifications in case "earthworks" were needed for defense. Then the whole band, now greatly augmented, swarmed across the bridge.

A lone ant of the new colony was out taking the air when he saw the hostile band come pouring toward him. He was brave, but he also was wise. Therefore he hurried back to the nest to warn the others. In a few seconds all his comrades were streaming out to the attack.

The carnage that followed was terrific. It sounds almost unbelievable, but the fight lasted for four days and nights.

On one occasion an armistice was arranged but it lasted only a few hours. Evidently the terms were broken by one side or the

ARMY Formation, Trenches, Truces, Spies, Prisoners, and Strategy Mark Strange 4-Day War—Facts about these Amazing Creatures

other, for the battle was resumed, and more wounded lay quivering on the white sand or floating helplessly in the water beneath the bridge, while dead bodies lay strewn around everywhere. With their big mandibles, the warriors slashed at one another in individual combat. They tossed the weaker ones into the moat; or, failing this, cut off their opponents' limbs and left them helpless.

BY THURSDAY afternoon the invaders from the old colony had been driven back across their bridge and practically annihilated. Their fortifications were useless, for the rout was complete. The new ants took some of their captives for slaves, killed the rest, and then went back home. The workers cleared the dead from the field, and all was peace.

The intelligence and power of organization shown by the ant in time of war is no less marked in time of peace. This amazing little animal not only is an efficient warrior; he is also an architect, a mathematician, a perfect nursemaid, a professional strong man, a farmer, a doctor, and an undertaker of distinction. He displays teamwork and a force of will, equaled only by his fondness for gay life (including, alas! intoxication) and sports. Doctor Hermann Eidmann, famous entomologist, of Munich, Germany, assures us, too, that the ant can talk!

Consider, first, his skill as an architect. In East Africa may be found tall, slim towers of earth built up by the white ant, or termite. Some of these towers are 20 feet high. Imagine a creature only a quarter of an inch long constructing a piece of architecture 20 feet in height! It is as if the ancient Egyptians had built 12 pyramids, one on top of the other. And the Egyptians at least had primitive

A Skilful Home-Builder

This is the home of a carpenter ant, an insect that is an expert architect and builder

The Strength of an Ant

In a laboratory test a little field ant held in its jaws a weight 3000 times heavier than itself. To equal that exploit a man would have to dangle from his jaws eight freight cars loaded with iron

tools, while the ant works with nothing except the limbs that nature gave him.

IN THE mountains of Pennsylvania are found some of the largest "ant cities" in the world. Most of them are built under ground, and the biggest one covers 30 acres. Think of 30 acres of ants! Think of the bewildering complexity of the subterranean passageways, and you will wonder how an ant ever finds his way back to his starting-place. Yet he does, by some mysterious sense of direction.

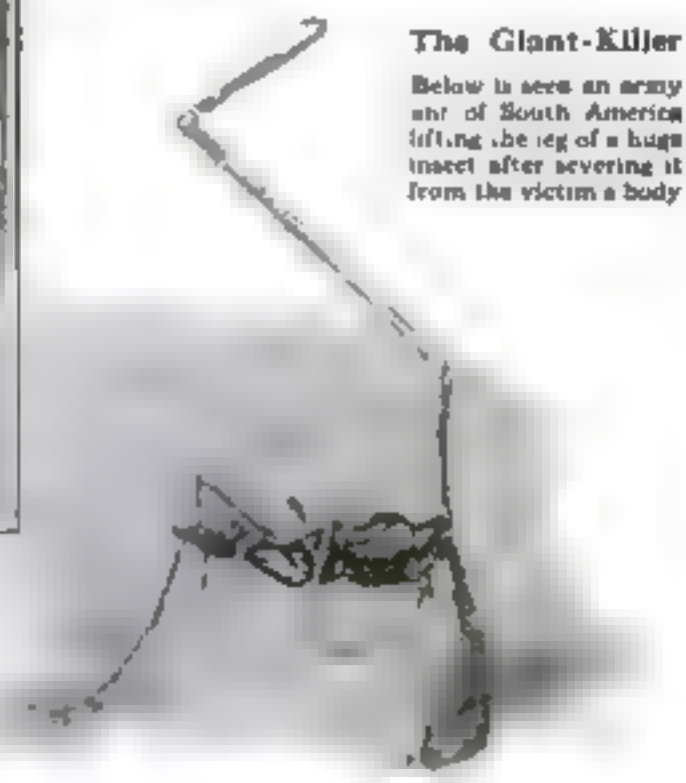
The ant is the most efficient builder in the world, for he carries all his "tools" and material with him. For instance, he can make a sort of millboard for his home by chewing up certain vegetable matter and causing it to stick together by means of a glue secreted in his glands.

Perhaps the most striking demonstration of the ant's intelligence is afforded by the manner in which he builds a shelter among the branches of a tree by "sewing" leaves together. The full-grown ant can spin no "thread," but the larva can, for it has to make a cocoon. So the adults fetch up their larvæ, which have been spinning their silk cocoons. A number of worker ants pull the edge of two leaves together. An adult holds a larva in its mouth, pokes the latter's head down on the leaves, and the little larva begins to emit silk at a good rate. The ant holding it draws it back and forth across the two leaves, and since the silk sticks and hardens almost immediately, a large number of such contacts have the value of stitches, and the "sewing" process soon is finished.

The ant was the originator of the co-operative institution. He knows more about teamwork than any 40 football coaches combined.

JUST for callous curiosity, take a spade some day, find an ant hill, and cut it clean in two. Then notice what happens. For a few minutes the little animals will run around in desperation, but soon, as if some mysterious voice were commanding them, they will stop their aimless scutterings and get down to work, each doing the task nearest at hand. One will pick up the pupæ, which cannot stand the light of day, and carry them into the deeper caverns; another will seize a grain of sand and start to repair the nearest breach; still another will carry away any débris that has fallen in the tunnels.

And the most peculiar thing about it all is that apparently no one ant directs the work. There is no leader, no boss. Yet they work like a machine.



The Giant-Killer

Below is seen an army ant of South America lifting the leg of a huge insect after severing it from the victim's body

THIS spirit of co-operation extends even to the fallen brothers, as exemplified in a rather laughable experiment once made by Sir John Lubbock. Sir John took a few unfortunates, made them drunk on hard liquor, and put them on a highway where sober ants were hurrying back and forth. The sober ones were quite excited at this disgraceful spectacle, and probably somewhat scandalized, but they picked up the drunken ants and took care of them, nevertheless. To be truthful, one thing must be noted: Some of the drunken ants were strangers, and these the sober rescuers ducked in a pool of water near by. Their friends, they took home to safety. One must discriminate, of course.

Did you ever think of the ant as a mathematician? Not that he delves into

(Continued on page 173)

Submarine Trains to Run on Stilts?

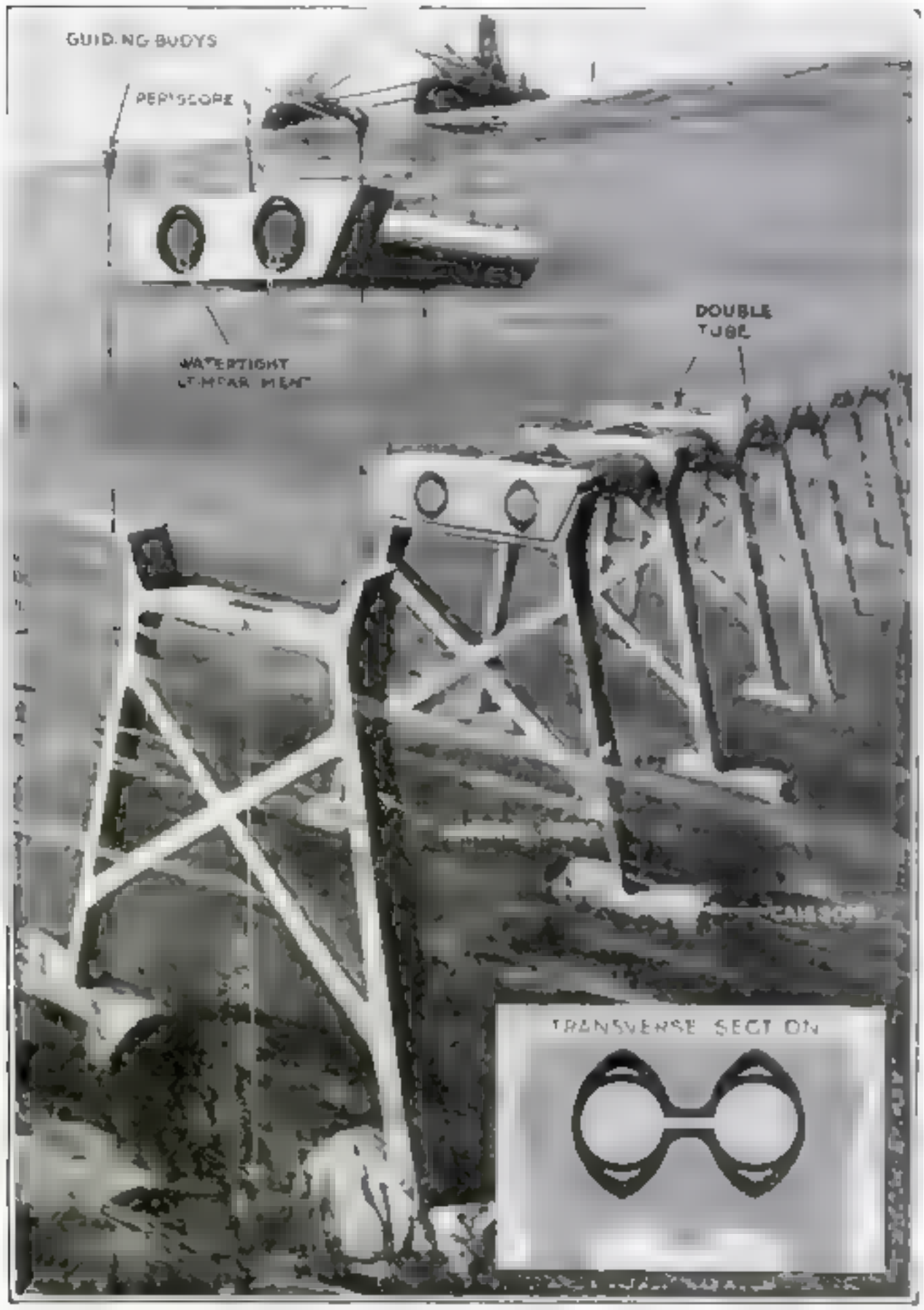
Engineer Plans Channel Tunnel Built on Great Concrete Piers

FOR more than a century, one of the most fascinating problems to the European engineer has been the building of a tunnel under the English Channel, to link France and England.

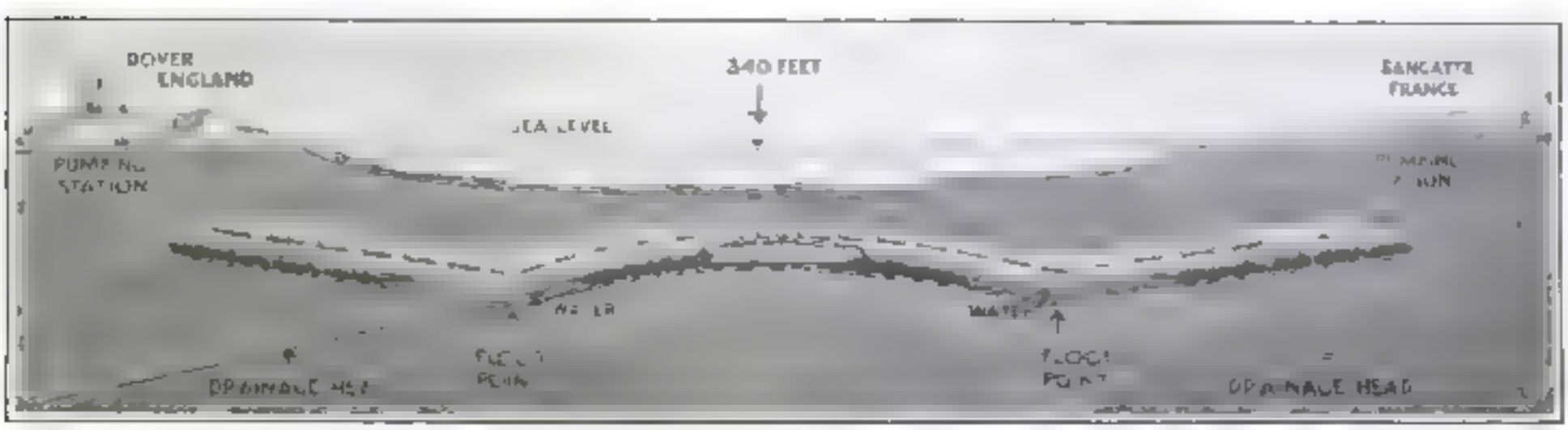
One of the latest schemes is that of a Frenchman, Commandant Veyrier. He proposes that, instead of boring a tunnel through the bedrock of the Channel, a succession of great reinforced-concrete piers shall be anchored to the sea bottom by means of strongly ballasted caissons. The piers would be sunk 340 feet from the surface. Once the piers were anchored securely, Commandant Veyrier's plan calls for a double-tube railway laid upon them, a section at a time, and fastened firmly to the supports, as shown at the left.

At the end of every section of the tube railway would be a watertight compartment similar to the watertight bulkheads with which all modern vessels are fitted. These compartments would insure a greater amount of safety in the tube, since if one part of it were flooded, the rest could be shut off immediately. Each tube would hold only one railway line—one for eastbound and the other for westbound trains.

Another engineer's plan, submitted to the British Houses of Parliament not long ago, was to bore a tunnel through the bed of the Channel. This tunnel was to be slightly higher at each end, sloping downward perhaps a quarter of the distance, then slightly arched across the center. This was planned so that, in the event of enemy invasion, the tunnel could be flooded from either end.



A French engineer's plan for building an undersea route between France and England across the English Channel by anchoring gigantic concrete piers to the seabed as a foundation for a two-tube railway



An earlier scheme for submarine transportation under the English Channel. This is a double-tube tunnel, built with sloping ends and a slightly arched center. A control mechanism at each end would enable either France or England to flood the tunnel in case of an invasion by an enemy

WHAT Kind of CHILDREN Will *You* Have?

Whether They'll Be Tall, Short, Fat, Thin, Sturdy, or Weak Now Can Be Told with Surprising Accuracy

By G. B. Seybold

WILL the new baby have brick-red hair like his father? What chance has he for genius? Is there any lurking possibility that he may inherit insanity, tuberculosis, or other dread disease?

Twenty years ago such questions about an unborn child would have been dismissed as futile. Today these and scores of other questions concerning inheritance can be answered with a startling degree of accuracy.

The other day in the Psychopathic Laboratory of the Municipal Court of Chicago, two unique machines were installed that seem to possess the amazing function of forecasting heredity. With a knowledge of the traits of your parents and grandparents, you may set the dials of the machines, give them a spin and read instantly the probable traits of your children, based on the latest theories and the known laws of heredity

These machines, under the direction of Judge Harry Olson, Chief Justice of the court, were designed by Dr. Harry H Laughlin, an expert on eugenics and heredity Their first purpose is to determine how largely heredity is responsible for crime, and already they are being applied to practical advantage.

Amazing Machine Tells What Children May Inherit

Chief Justice Harry Olson, of the Chicago Municipal Court, with the remarkable machine invented to forecast traits that children inherit In the center of the device are two rows of spools. The spools on one side represent the 24 chromosomes, or agents of heredity, contributed by the mother. The other 24 represent those contributed by the father. Possible combinations of traits that the children of these parents may inherit are listed by spinning the spools around

But in addition to determining responsibility in crime, the machines demonstrate graphically and understandably, many of the other mysteries of human heredity.

One device consists of an upright grooved board covered with glass. Lead pellets, representing children, are dropped into the top and fall through various sets of grooves, each set representing a generation. The distribution of the pellets shows how children may be divided in succeeding generations in regard to various traits. If there is an inheritable disease or other taint in the family, for example, the percentage of those affected in each generation will be shown.

The other machine is based on what are known as chromosomes—mysterious, rod-shaped, microscopic particles in our bodies that science has discovered are the agents of heredity. Every living species of animal has a definite number of chromosomes in the nucleus of each of its cells. Man has 48.

A human cell is so small that there are 70,000,000,000 in a cubic inch of blood. Yet stored in each of these tiny specks is a wonder box of human characteristics. In fact, chromosomes often have been likened to a tiny box filled with a number of traits. The manner of the chromosomes' meeting (24 from the mother and 24 from the father) determines the characteristics of the children.

Three Sets of Twins in Three Generations

These three generations of twins, who live in Omaha, Neb. offer striking evidence that the tendency to produce twins is inherited. Strange to say all celebrate their birthday within 10 days of one another In the center are Alton Avery and Mrs. Alta Avery Voorhees twin brother and sister 71 years old. The two women at the sides are Mrs. Jennie Avery Robb and Mrs. Josie Avery Hanson, 31-year-old twin daughters of Alton Avery and the children are Jean Avery Robb and Bonnie Avery Robb, three-year-old twin daughters of Mrs. Robb

THE possibilities for combination of traits are tremendous, because not only do the chromosomes link up in different ways, but their contents interchange. More than 6000 definite human qualities have been named so far. When all of the chromosomes shall have been identified, the estimated number of traits possible in human beings is expected to exceed 1,500,000.

On the other machine, a row of 24 spools at the right represents the 24 chromosomes contributed by the father; a similar row at the left, the chromosomes of the mother. By spinning the spools, the possible traits of the children may be determined

Different traits assert themselves in different ways. Some are called dominant, which means that they will assert them-

selves over any trait of a contrary nature. A dominant trait will appear in all children. For example, if a father has baldness as a dominant trait, all of his boys very likely will be similarly bald and no hair tonic on earth can prevent it.

Recessive traits, those that are weaker and tend to disappear, on the other hand, may skip one or more generations only to reappear, in which cases usually only a small number of the family are affected.

It is because of this that marriage of first cousins so often is discouraged. Having chromosomes packed with common traits, the union of cousins intensifies the possibility of the bad traits affecting their children.

IF THE ancestry of cousins is fine and free from bad traits, no possible harm can result from their marriage, is the belief of many eugenists today. Doctor Douglas P. Murphy, of Rutherford, Conn., has been observing for many years a family in North Carolina in which there were seven marriages between first cousins following direct lines of descent. He reports that no effect can be noticed detrimental to the health of the children. Mental deterioration, physical abnormality, and lowered vitality, said to result from such marriages, occurred in no instance

The laws known as the Mendelian ratio, that explain the distribution of dominant and recessive traits, really are laws of chance.

A very tall man marries an unusually short woman. His tallness dominates her shortness, and all of their children are tall. But while each member of this second generation is tall, each carries within him chromosomes for producing short children as well as tall ones. If one of the second generation has four children, one of these probably will be tall, one very short, and two tall-short or medium. The extremes of this generation "breed pure." That is, the tall child will have only tall children, the short one only short children; but the two with mixed traits each produce one tall, one short, and two a combination of both traits. The little lead pellets dropping into grooves of the new heredity machine, falling where they will through chance, show how this surprising ratio works out

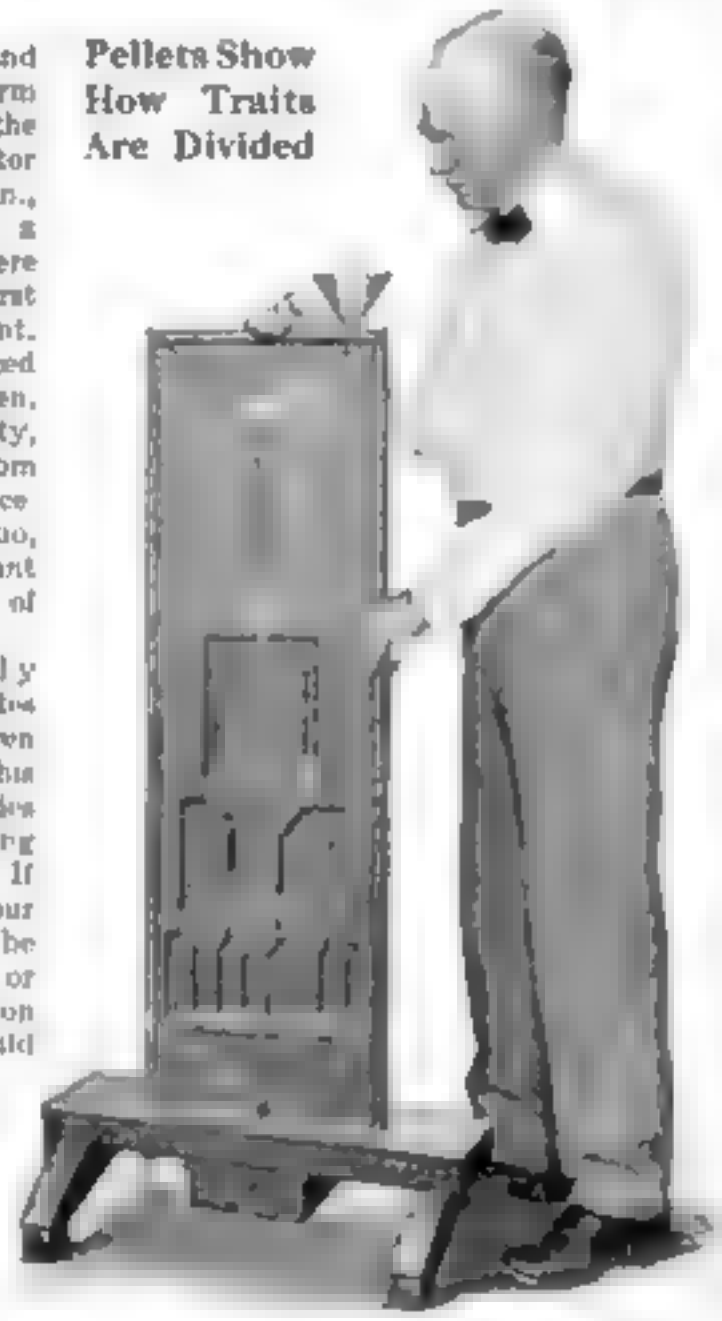
THE operation of each machine is based on a previous knowledge of what traits are heritable, obtained by long experiment with lower animals and study of family histories

Bodily build, for example, is clearly inherited, as is the color of the skin, eyes, and hair. Red hair is dominant over dark. Dark eyes are dominant over blue or gray ones, dark skin over fair.

More remarkable is a recent interesting conclusion that your weight is hereditary as well as your height. Mrs. Jones, who takes the scales at 210 pounds, complains, "But I don't eat as much as my husband, and he stays thin" Doctor C. B Davenport, director of the station for experimental evolution of the Carnegie Institution at Cold Spring Harbor, N. Y., explains that Mrs. Jones probably has ancestors who passed on to her the quality of turning food into fat. "Children of two thin persons," says Doctor Davenport, "never will grow fat. Fat persons, however, may have children who always will remain thin."

Differences in sex have been found to be determined by heredity, but rules for its behavior have not yet been found. It is known from observation that through certain lines of descent the girls outnumber the boys, or vice versa. Doctor Clarence C. Little, who has made a special study of this, tells us that more boys than girls are born when the parents belong to different European races than when they belong to the same race. But exactly what proportion of children of any two parents will be girls and how many boys, cannot yet be determined.

Pellets Show How Traits Are Divided



Another of the heredity machines invented by Dr Harry H Laughlin, eugenics expert. Lead pellets representing children are dropped into the top of an upright grooved board Each set of grooves represents a generation. The distribution of the falling pellets indicates how children may be divided by traits in succeeding generations

A tendency to produce twins has been shown to be inheritable Doctor Davenport found that the fathers of twins are about as likely to belong to twin-producing families as are the mothers of twins in other words, that twins depend on the heritage of both parents.

HUNT up the family records of the old-timers, those who lived to a ripe age of 90 or 100 years, and you will find evidence that long life is another inherited trait. The best assurance of long life, advises Prof Raymond Pearl of Johns Hopkins University, after long experiments, is to pick out long-lived parents and, before that, grandparents.

We all are wound up like clocks. Professor Pearl explains, some for short and others for long periods. Your length of life depends largely on whether you have a strong and vigorous constitution, and this is determined by the combination of traits handed down to you.

Of course, the fact that you are wound up for 90 years doesn't mean, necessarily, that you will live that long. An eight-day clock may fall off the shelf on the second day and stop ticking; you may sink in a pond while swimming, and stop ticking, too. Or, if you live rapidly and strenuously, as did Theodore Roosevelt, you may have a more interesting time, but will use up your alloted period and die earlier

Doctor Pearl based his conclusions partly upon experiments with banana or fruit flies, whose life cycle has been found to be extraordinarily similar to that of man. A day in this fly's life is equal to a year of man's. At 90 days the fly is as decrepit as a man of 90 years. Watching the length of life of these flies through successive generations, convinced Doctor Pearl that heredity is the dominating influence in longevity.

He tested the effect of speed in living on four albino rats kept in a revolving squirrel cage. The average age at which these hard-working rats died was 29.6 months, while three rats confined in stationary cages attained an average old age of 40.3 months.

ALONG similar lines, Prof. M. F. Guyer, of the University of Wisconsin, announced recently after years of experiment that it was possible for mothers to transmit resistance to disease to their children. By inoculating successive generations of rabbits with germs of typhoid fever, he said he was able to develop in their blood an anti-body that the mother transmitted to her offspring, making them immune to the disease. Rabbits of the fifth generation were able to withstand 30 or 40 times as many typhoid germs as the original rabbits.

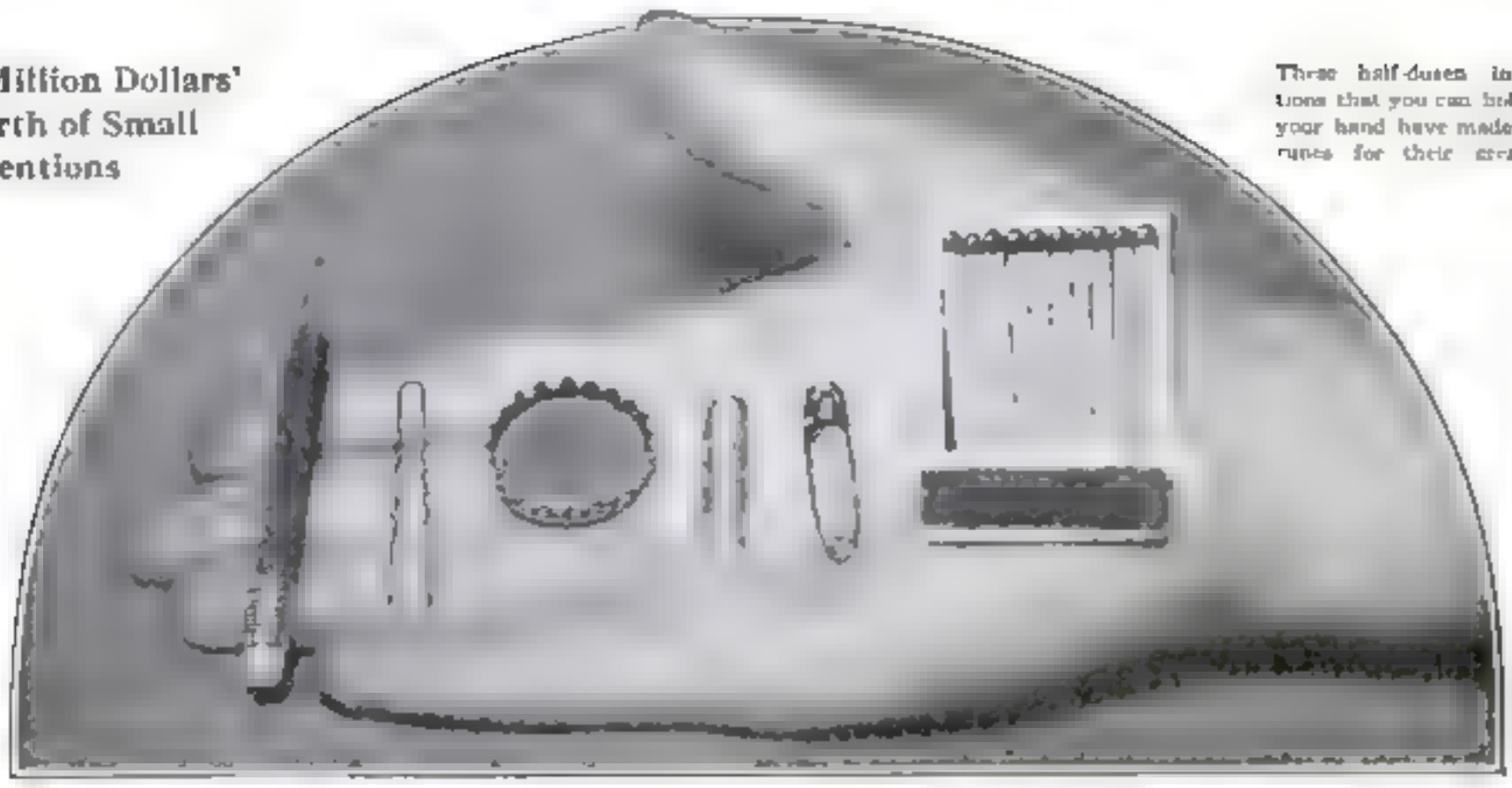
Malformations and weaknesses, unfortunately, are heritable, science tells us. Even worse, the majority of those so far investigated are found to be dominant traits. Extra fingers or toes, union of fingers and toes, a white lock of hair, cataract of the eye, drooping eyelids, night blindness (inability to see a faint light), color blindness, defective eyesight, scaly skin, deficiency in sense of smell, toothlessness, abnormal tendency to hemorrhage, very small eyes, certain forms of deafness, St. Vitus dance, syphilis, and epilepsy all are passed on through chromosomes.

ANY mutilation or destruction to a part of the body during a lifetime, either through accident or disease, of course is not passed on. If a man loses a leg in a railway accident, his children will have two good legs just the same. Certain breeds of dogs have had their tails clipped short at birth for hundreds of generations, but the new-born puppy wags a tail as long as the one his ancestor had centuries ago.

Heredity often is blamed for diseases

(Continued on page 140)

A Million Dollars' Worth of Small Inventions



These half-dozen inventions that you can hold in your hand have made fortunes for their creators

Why Simple Inventions *Have* Proved Most Profitable

Even the Safety-Pin Made a Fortune—Everybody Needed It

By Arthur Grahame

A MAN of inventive turn of mind spent an afternoon on the golf links. He watched each player, before he drove off, take a handful of damp sand from a sand-box on the teeing ground, kneel, and fashion a more or less symmetrical mound of sand upon which to perch the ball. It seemed a messy, bothersome process, and it had to be gone through 18 times on each round of the course. There must be a better way.

He thought it over inventively. The result of his thinking was a patented golf tee consisting of a pointed pin of light wood with a slightly concave head.

There is nothing startling about this invention. The tee is not much more in effect than a glorified carpet tack. It is one of those simple but ingenious things that "anybody might have thought of." But golfers buy it. Several million have been sold. There was a ready-made demand waiting for the novel little tee, and its retail price is so low that almost any player is willing to "take a chance" and give it a trial.

Another man of an inventive turn of mind saw London nursemaids pushing baby-carriages along the sidewalks. He decided to invent a motor baby-carriage. He did invent one, and patented it. The nurse stands on a platform behind the carriage and pilots it along at a dizzy speed of five miles an hour.

This motor baby-carriage is a much more complicated apparatus than is the little golf novelty. It cost more in time and effort to perfect and to manufacture, and it costs a great deal more to buy it. Yet it is extremely unlikely that its inventor will reap nearly as large a financial harvest as will be gathered by the inventor of the simple little golf tee. There are even more babies than there are golfers in the world, but only a few parents are able and willing to invest in motor baby-carriages.

If you want to make your inventive ability pay you big dividends, invent something that great numbers of people will want and will be able to buy—something that will do away with or lessen some petty annoyance of ordinary life, and that can be manufactured and sold cheaply.

Many of the most profitable inventions have been extremely simple—among others, the safety-pin, "Mrs. Potts'" flat-iron with the detachable handle that stays cool while the iron gets hot, which made a half-million dollars for its inventor, the crinkled hairpin that stays put in a woman's hair, and Eskimo pie, that comparatively new hot-weather delicacy that earned a big fortune for the man who patented it. A big demand was waiting for every one of these inventions.

"I HAVE found that a much larger consideration can be secured for an invention if you can *prove* that a market exists for it," said a professional inventor of small articles, when I asked him what, from his 20 years of experience, was the first requisite of profitable invention.

"The first step in invention, if one has no particular invention in mind," he went on, "is to examine various articles in general use and see if an improvement can be made on one of them—an improvement that will make the article do better work, and that will make it less costly."

"I DRIFTED into the business of invention during a long siege of ill health," another inventor told me. "Trying to find some way of passing the time, I bought a guitar. I soon tired of merely strumming the chords and playing a few simple exercises, and devised a new method of stringing that, to my surprise, made it possible for me to play popular airs on this heretofore rather limited musical instrument. I secured a patent on my improvement, and before long two manufacturers were paying me substantial royalties.

"After I got back my health I devised another musical instrument, a combination of the mouth harp, or harmonica, and the zither, the tune or melody being played on the harp while the accompaniment was being picked out on the strings. Local capitalists financed this invention and we soon had a prosperous business, which was under my management. And from that time I have devoted myself exclusively to invention."

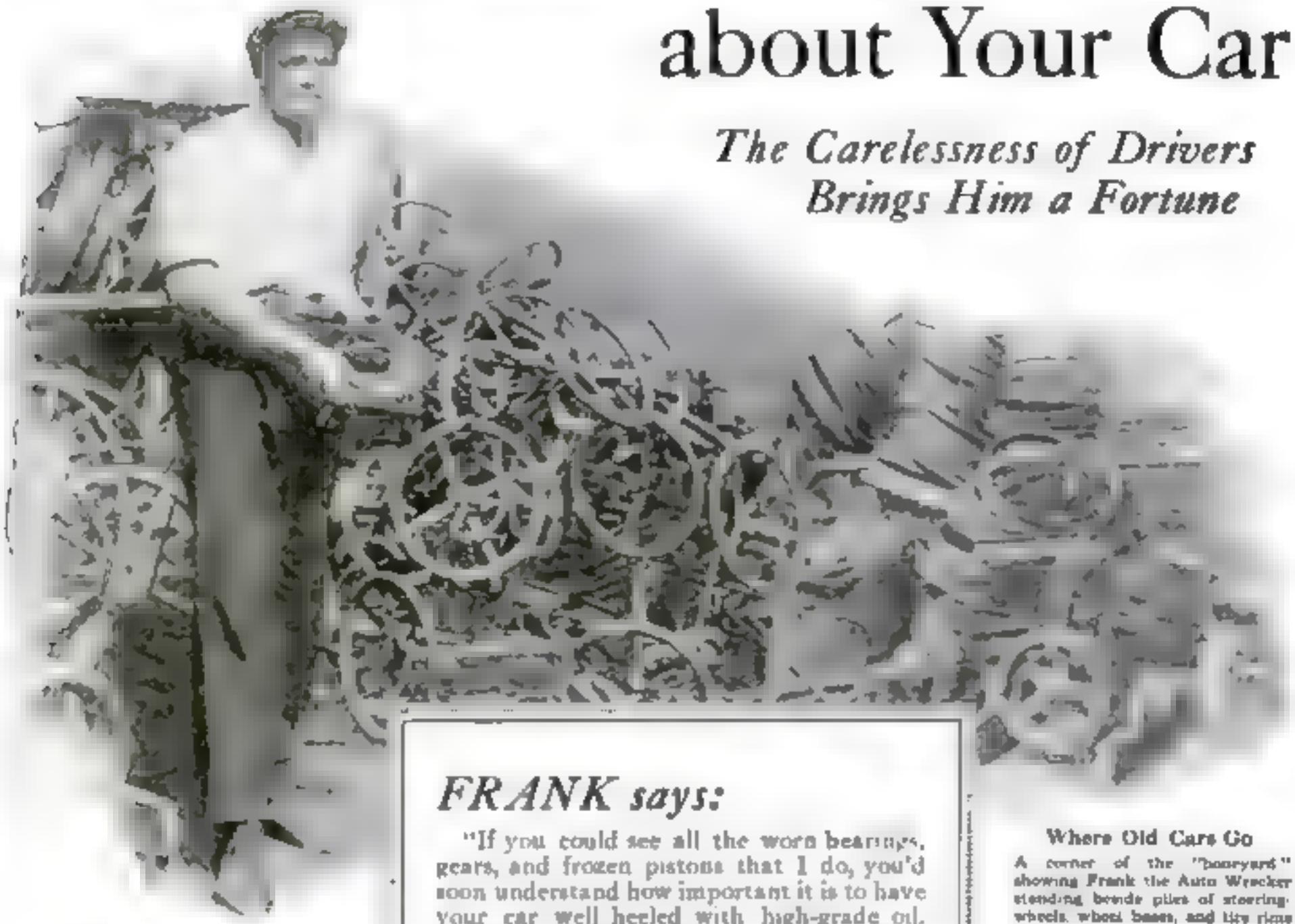
Another inventor explained to me a system of marketing his products that he had found profitable.

"Often," he said, "instead of offering an invention for sale, it is more profitable to the inventor to organize a local company to manufacture it, taking stock and an

(Continued on page 142)

What a Junkman Has Learned about Your Car

The Carelessness of Drivers Brings Him a Fortune



FRANK says:

"If you could see all the worn bearings, gears, and frozen pistons that I do, you'd soon understand how important it is to have your car well heeled with high-grade oil. The poor stuff simply turns thin when it gets hot

"Plain carelessness of drivers ruins at least a million motor-cars every year. Reckless speeding, overloading, failure to learn how to drive correctly, and neglect of essentials such as lubrication, are the things that send cars to the junk heap—and I profit."

Where Old Cars Go

A corner of the "boneyard" showing Frank the Auto Wrecker standing beside piles of steering-wheels, wheel bases, and tire rims

By Edgar C. Wheeler

AT LEAST a million and a half of the seventeen-odd million motor-cars counted in the United States a year ago, have vanished from the road. While some three million new cars have come glistening from factories to take their places, this vast weather-beaten army of 1,500,000 vehicles—more than enough to form a single line clear across the continent—has passed silently and mysteriously into oblivion

Where have they gone and how? Have they simply been worn out and thrown into the junk heap? Are they represented by the tragic derelicts you occasionally see rusting and rotting away in some littered back yard or vacant lot? Just what has become of them, anyway?

On New York's upper East Side, near where the Queensboro Bridge throws its span across the East River, there is a cavernous brick building where rules a swarthy giant of a man. If you should have occasion to visit this place, you might believe you were stepping into some modern fairy story as grim and romantic as any tale of giants of old. For you would find this giant prospering amid huge heaps of the bones of vanished motor-cars. He would tell you, with a cigar butt in one side of his mouth and a smile spreading across the other, of the strange fates that have brought automobiles and motor-trucks by the hundreds and thousands there to his grim castle of wreckage. And he would tell you the secret of where the autos go:

"MOTOR-CARS don't wear out; we chop 'em up into hash!"

The name of this up-to-date giant is Frank—simply Frank the Auto Wrecker (nobody would know whom you meant if you called him Frank Palecek). And it is on the very fact, as stated by him, that motor-cars never wear out—never entirely—that Frank the Auto Wrecker has built a comfortable fortune within the last 10 years. He is one of a few aggressive and successful men throughout the country who of late have established a thriving new industry—that of "chopping up" used cars and reselling their parts for what cash they will bring.

Frank's business card says that he can supply you with "anything, from a crank handle up to a tail-lamp." In his three wrecking plants, one on the East Side and two across the river on Long Island, he has in stock the parts for 400 different makes of cars. He stores anywhere from 80 to 300 cars at a time, waiting for the slaughter. He has bought outright as many as 1126 cars at once. The vast heap of automobile "bones" piled in the rear of his building is a jumbled, unsorted mass of springs, steering-posts, transmissions—every item, in fact, that goes into the making of a motor-car.

On the floor in one corner is the rear end of an old Benz car of 1910 vintage, weltering in its own grease and oil, undergoing the "hashing" process.

Scattered about it are a score of nuts and bolts of as many sizes. The walls of a dark passage leading into the "boneyard" at the rear are lined with box-like compartments, each bearing the name of a particular make of car, and each containing an assortment of parts for that make.

A CUSTOMER comes in, a mechanic from a near-by garage. "Frank," he says "I want the aluminum crankcase from that last sedan you got out there in the

lot. Are you willing to break 'er up?"

"Sure," says Frank. "You can have it for $20." The mechanic pays down the cash and the deal is closed.

ANOTHER customer—this time a motorist. He wants a set of gears to replace the ones he has just stripped. Frank goes to the cupboard marked with the name of the man's make of car and pulls down a set of gears that shows very little sign of wear. "Just the thing," says the motorist. "If I bought this set new, I'd pay twice the price."

Thus, bit by bit, does Frank dispose of and profit from the cars that have seen their last days on the road. The story of his own rise to fortune offers a vivid illustration of how pleasure cars and motor-trucks disappear from sight by the million every year. Ten years ago Frank was in the trucking business in a small way and the business wasn't prospering. He was eking out a living with a single truck, and he had run that truck hard for seven years—so hard, in fact, that it had seen its best days. Whenever he went out on a job with it, he couldn't be sure of getting there and getting back.

Frank's ready cash was low. He didn't have enough money to buy a new truck, but he had an idea.

"I'll chop this old thing up," he said. And he did. Old and wheezy as the truck was as a whole, some of its parts were still in good running order, and he sold them for $25. With this capital in hand, he went out in search of more motors to make "hash" of. In a storage garage he found a truck that was held for rent, and he bought it for four dollars.

THAT was a bargain, and it gave him a real start. Selling the good parts, buying other cars, selling the parts, buying more cars—by this method the business grew, little by little, until it eventually brought him financial independence. He never keeps books nor price lists; but he knows every part of every car and what it is worth on the market.

"I've learned," said Frank, "that there isn't a single part of a car, no matter how old it may be, that isn't worth something. The working parts that still are good always can be used to repair other cars; those that are worn can be sold for scrap. The leather in the upholstery goes into making shoes and pocketbooks, the hair stuffing always is wanted by upholsterers. Assorted nuts and bolts I sell by the barrel to garage men. I even sell the old oil and grease—to the soapmakers."

Meanwhile, from his daily observation and study of his piles of chopped up cars, Frank the Auto Wrecker has gained a vast knowledge of the ways of motorists and why their cars leave the road to fall under his chopping-block.

"The average life of a car," he said, "is about five years. With some cars it is only two years. If at the end of that time a car is overhauled completely, it may last three years longer.

"Why don't cars stay longer in the running? There are a number of good reasons, but the chief one is poor lubrication—not only *lack* of oil, but lack of *good* oil.

"Just the other day a fellow came in here and sold me his five-passenger touring-car—three years old, and making a noise like a pack of lions caged in a sawmill. This bird was sad. Wagged his head. 'You know, I can't understand it at all,' he complained. 'A friend of mine bought a car just the time I did—the same kind of car, too,—and his is running good yet. And just look at mine!'

"'What kind of oil have you been using?' I asked.

"'Well, you see, I've been saving on my oil bill,' he told me. 'Found a place where I could get it cheaper—15 cents a quart most of the time—but I don't know exactly what kind of oil it was.'

"SO THAT poor oil was the finish of his car on the road, and that was why he brought his car in to me to be chopped up for hash. If you could see all the worn bearings and gears and frozen pistons that I do, you'd soon understand how important it is to have your car well heeled with high-grade oil. The poor stuff hasn't any body. It simply turns thin, like water, when it gets hot.

"But bad oil isn't the only reason why cars give out, by a long shot." As if to emphasize his point, Frank went to a pile of junk and hauled out a set of gears and a crankshaft that he had taken from a high-powered car.

"Look at this," he said, pointing to a crack clear across the first and largest gear. "The speeder who owned that car just couldn't make his left foot behave on the clutch. How do I know? Because I sold him two sets of gears beside this one. Every time he would go to start that high-powered car of his, instead of easing the clutch in slowly, he'd let 'er in with a jerk that would tear away at the workings. Something was bound to give sooner or later—the gear, the shaft, or the rear end. In this case the gear cracked straight across. He never could learn, or at least he never took the trouble to. Finally he got disgusted and sold me the whole outfit. Said he wanted a new one."

A MACHINE that obviously had been through a frightful wreck lay close to the pile of parts, a ghastly mass of splinters and twisted metal.

"Now that," said Frank, "is the kind of a mess I get from a driver who won't take it easy. You've seen the kind I mean many a time. He drives by fits. One minute he's going 50 miles an hour, and the next minute he's jamming on the brakes. Never can seem to move easily along at an even pace.

"Every time this fellow slammed on his brakes, he not only wore down his brakes, but he racked the driving mechanism from stem to stern, he wore out his tires, and he put a terrific strain on the whole car. And at last he got what was coming—as nearly all such drivers do sooner or later. One evening when he was going like mad, he hit a sharp turn in the road. He jammed his brakes, as usual, but the terrible side strain as he made the turn actually pushed one of his front tires clear off the rim. He lost control, landed in a ditch. And this here is all that was left."

In Frank's place there was plenty of evidence of other kinds of carelessness and recklessness. One machine a pitiful ghost of many a joyous motor party—drooped and sagged, for all the world like a broken-down, overworked nag.

FRANK stood studying the wreck for a moment, then conjured up a vision of the machine when it was sleek and new. It had been a light five-passenger sport model of a popular make, he recalled. The owner, when he bought it, had been wildly enthusiastic. "Come on, folks," he had said to his neighbors, "let's all take a ride." And they all piled in—10 of them. Some crowded into the seats, others rode the runningboards, and others sat on the fenders. The springs sagged. Everything sagged. The sleek new car groaned under twice the weight it was supposed to carry. The motor strained to pull the load. And that was the beginning of the end of the machine's short life of usefulness.

"This business of overloading," rumi-

(Continued on page 141)

How Auto "Hash" Is Assorted According to Make

The parts of "chopped up" cars are sorted into bonfire compartments, each bearing the name of a particular make. Frank has in stock the parts for 400 different makes of cars—anything "from a crank handle to a tail-light," and innumerable nuts and bolts

There's Magic in Numbers

Simple Tricks with Figures that Will Mystify Your Friends—How to Read Your Fortune with Numerals

By Karen Adams

IF YOU have no head for figures, don't worry about it—you're in good company. Any number of clever, even brilliant people are terrified by arithmetic, while the very thought of the higher mathematics makes their heads reel. There is a sort of inhuman morality about numbers. They cannot lie. They are incorruptible.

However, even the uncompromising numbers have their moments of relaxation. While they cannot lie, there are times when they seemingly do so; and they amaze and deceive the most scholarly And also they have powers and qualities quite distinct from their purely scientific and ordinary uses.

Among these we may include the powerful influences exerted by certain numbers all through recorded history, in mythology, and even in our life today Take the sinister 13. Who will deny its power? Again, there is the mystic 7, symbol of luck since numbers were invented It has been dramatized and exalted above all numbers

The 3 was featured highly in pagan systems of religion. It is the number of finality expressing the superlative degree of effort or excellence. We have it in the auctioneer's "third and last call"; children use it in their games; the hero always wins out on the third attempt.

NINE is the highest-powered digit, hence it always has been associated with quantity, magnitude, and ideas of grandeur. It is susceptible of more juggling than any other numeral. One of its many peculiarities is that the digits of any of its multiples, when added together, always total 9. Thus, 3 times 9 equals 27. The digits in this, 2 plus 7, equals 9. Try any other combination and you will get the same result.

Among the most interesting number stunts with which it is comparatively easy to mystify your friends are "boomerang" tricks, so called because of the process of sending a number forward by addition and multiplication, and bringing it back by subtraction and division.

In an amusing game of this nature one may determine a person's age. The trick proves very puzzling, yet it is really simple to perform. Supposing the subject's age is 16, this is the way you will determine it:

Tell the subject first to multiply by 2 the number of the month in which he was born. Say he was born in August, or the eighth month, then

2 times 8	equals	16
Add 5	"	21
Multiply by 50	"	1050
Add age (15)	"	1065
Subtract 365	"	700
Add 115	"	815

The subject does all this figuring as you direct and gives you the final total, 815. You then are able to tell him he was born in August (first number, 8) and is 16 years old (last two numbers).

A more elaborate stunt is to determine a figure erased from a series. Ask someone to think of four or five figures, or even more. Say he takes 45986. Tell him to add the separate digits; 4 plus 5 plus 9 plus 8 plus 6 equals 32. Have him subtract the result (32) from the original figures, which leaves 45954. Then have him strike out one figure from the 45954. Ciphers cannot be stricken. Say he strikes out the 4. Then have him total the figures that are left.

Five plus 9 plus 5 equals 23. This total he gives to you. You then think of the nearest multiple of 9 higher than the total, which in this case would be 27, 3 times 9). You then subtract the total, 23, from 27, leaving 4, which, you tell him is the number he struck out. If the total he gives you is an equal multiple of 9 such as 18, 27, or 36, then the number he struck out is a 9

A similar trick appears very mystifying. Ask a person to think of two numbers, from 1 to 8. You then offer to tell what the numbers are. This is the way to do it

Suppose the numbers the person had in mind were 4 and 6. Ask him to double the first number

2 times 4	equals	8
Add 5	"	13
Multiply by 5	"	65
Add second number (6)	"	71

YOU then ask to be told the total. From the total (71 in this case) you subtract 25, leaving 46. The number at the left is the final figure is the first number your subject chose, and the number on the right is the second. This trick can be done with two dice, guessing the numbers on the upturned faces without seeing them.

Here is another trick that proves very baffling. Have some one set down a number containing five figures. With this before you, you write down a number on another sheet of paper, which you fold and ask the subject to keep without looking at it. This concealed number will be the answer. Under the first row of figures the subject sets down another row of five. Under that you put a row The subject then adds another row and you do likewise, making five rows altogether Ask the subject to add the

(Continued on page 157)

A Mystifying Table that Tells Your Age

1	2	4	8	16	32
3	3	5	9	17	33
5	6	6	10	18	34
7	7	7	11	19	35
9	10	12	12	20	36
11	11	13	13	21	37
13	14	14	14	22	38
15	15	15	15	23	39
17	18	20	24	24	40
19	19	21	25	25	41
21	22	22	26	26	42
23	23	23	27	27	43
25	26	28	28	28	44
27	27	29	29	29	45
29	30	30	30	30	46
31	31	31	31	31	47
33	34	36	40	48	48
35	35	37	41	49	49
37	38	38	42	50	50
39	39	39	43	51	51
41	42	44	44	52	52
43	43	45	45	53	53
45	46	46	46	54	54
47	47	47	47	55	55
49	50	52	56	56	56
51	51	53	57	57	57
53	54	54	58	58	58
55	55	55	59	59	59
57	58	60	60	60	60
59	59	61	61	61	61
61	62	62	62	62	62
63	63	63	63	63	63

To learn a person's age, ask him to tell you in which column or columns of this table his age appears. Then add the figures at the top of the columns he names.

If, for example, his age is 36, he will tell you that his age appears in the third and sixth columns. The top figures of these columns are 4 and 32, which, added, give the correct answer.

Is Sleep Just a Useless Habit?

Scientists Seek to Reclaim the Hours Now Lost in Slumber

By Newton Burke

THOSE eight hours out of every 24 that you, like most of the rest of us, spend in the mysterious stupor that we call sleep—what is their purpose? Practically a third of your life you spend in the blank unconsciousness of slumber. Is this really necessary, as physicians long have believed, to rest your tired body and mind and restore your nervous energy? Or is it simply a useless and tragic waste of a third of the precious hours of a lifetime?

A few weeks ago eight students of George Washington University—four men and four women—under the supervision of Prof. Fred A. Moss, head of the university's Department of Psychology, voluntarily submitted themselves to a test of 60 continuous hours of wakefulness. One purpose of the experiment was to answer this very question—of whether sleep actually is vitally necessary. And while the answer was in no way conclusive, it seemed to tend to corroborate the conclusion reached by other scientists in recent months.

That sleep, instead of being a "blessed thing," really may be a wasteful habit handed down to us by our primitive ancestors.

While Professor Moss declares his experiments are just beginning, his findings in the first test with the eight university students reveal these surprising discoveries:

Sleep really is a kind of intoxication. Like drunkenness, it has to wear off. Too much sleep, like too much intoxication, actually may be harmful, deadening the activities of mind and body.

Some persons can sleep faster than others. By training yourself to sleep rapidly, you should be able to sleep the equivalent of your present eight hours in six hours, thus adding two hours, or 25 per cent, to your normal allotment of eight hours for productive work.

IN THE last three years Professor Moss has reduced his own period of sleep to six hours without impairing his efficiency.

While prolonged wakefulness causes extreme drowsiness and irritability, apparently it does not result in any harmful effects on the body. At the end of their long vigil, the eight students declared they felt "in fine shape." Indeed, two of them, Watson Monroe, 17 years old, and Lester Petrie, 35, were not satisfied when they reached the 60-hour goal, but extended their sleeplessness to 80 hours. And even then they expressed their willingness, when they were ordered to bed, to keep awake indefinitely.

Further, in tests of the students' ability to drive cars, Professor Moss found that while a person's capacity for operating an automobile is lessened after 50 hours without sleep, there is a noticeable improvement after 55 hours.

Similar indications that sleep may be nothing more than a habit that can be thrown off, at least to some extent, were developed during experiments several months ago by Dr. Nathaniel Kleitman and Dr. N. F. Fisher at the University of Chicago, and described in the July issue of POPULAR SCIENCE MONTHLY. Remaining awake for five days and four nights—115 hours, to be exact—they found they could shake off the invasion of slumber by keeping their muscles contracted.

Among notable scientists who have been studying the mystery of sleep, there is one—Dr. H. L. Hollingworth, professor of psychology at Columbia University—who has gone so far as to advance the astonishing theory that it may be possible to develop a sleepless race. He declares that eventually we may eliminate sleep entirely by scaling it down gradually and getting accustomed to going without it. A way to do this, he suggested, is to reduce our sleep five minutes every two months. At the end of 16 years, provided we start at eight hours a night, "the stupor of sleep would be banished—if it could be."

DOCTOR HOLLINGWORTH calls sleep a "tragedy to which we should give the same consideration that we do to other human ills." His theory is that our deep-rooted desire for slumber is inherited from our remote ancestors who, when night fell, were hemmed in by a wall of blackness. Without lanterns and without electric lights it was impossible for them to carry on the activities of the day. They had nothing to do, and naturally when night came they fell into a sort of blank stupor which continued until daylight returned.

That, says Professor Hollingworth, is why so many of us begin to feel drowsy when night comes, and why you nod and go to sleep before your fireplace at the end of the day.

Other scientists, notably Dr. Fraser Harris, Dr. A. W. Crile, and Prof. Arthur Cotton, are endeavoring to find a substitute for sleep. Believing that the need of slumber is caused by electro-chemical reaction in the brain cells, which drains them of their vitality, Professor Cotton has been working on an electric apparatus that he believes will recharge the worn-out cells by direct electric current instead of by sleep.

Whatever may be the final solution to the every-day mystery of sleep, the fact remains that some men can do without sleep to a very large extent and still achieve great things. Thomas Edison, for one, has given striking demonstration of his pet theory that sleep is largely unnecessary. Such men as Napoleon, Frederick the Great, Schiller, and Tesla have been satisfied with from three to five hours' sleep daily. If they can do it, why not everybody?

AN AVERAGE man of 45 years today has spent about 15 years of his life in slumber. Despite the latest experiments, however, it is the consensus of scientific opinion that thus far there has been developed no way for the average man to reduce his sleep materially without a bad effect on his health.

They Stayed Awake for 60 Hours

Professor Fred A. Moss (center) head of the Psychology Department of George Washington University with the eight students who stayed awake for 60 hours and more under his supervision. Front row left to right: Lester Petrie, Thelma Hunt, Professor Moss, Katherine Ormsbee and Robert Ward. Back row left to right: Dr. W. Middleton, Alice Hauser, Louise Ormsbee and Watson Monroe. Two of them kept awake for 80 hours

What Airways Promise *Us*

Vast Network of Freight and Passenger, Mail and Express Lines to Cover Entire Nation

By Robert E. Martin

A FEW weeks ago a grand piano was transported by airplane from New York to Washington! Twenty years ago you would have been laughed out of court if you had suggested such a thing; but today it actually has been accomplished. Today it is possible to transport not only grand pianos, but almost any article you could name, from a sewing-machine to a kitchen stove, all the way across the continent through the air from New York to San Francisco. In fact, only recently a wealthy sportsman even negotiated to have a race horse carried from one city to another across the sky!

Such marvels of transportation, undreamed of only a few years ago, simply testify to the fact that America, undaunted by tragic mishaps like the loss of the *Shenandoah*, is forging ahead in aerial navigation to an extent that is amazing the world. Mail routes, passenger routes, freight routes now existing form a nation-wide network of airways that promises before long to cover the United States more thoroughly and speedily than any other means of transportation.

The necessity of rushing a piano through the sky is not apparent, but there are other types of freight where speed of transportation means a tremendous economy. In carrying perishable vegetables and fruit, for instance, the need for hundreds of tons of ice to keep them in perfect condition does not exist on the air routes. In the first place, the fruit is transported so quickly that it has no time to decay and, in the second place, the pilot of the freight airplane always can seek a higher level where the air is extremely cold, even in summertime.

AS FAR as passengers are concerned, the airplane now has taken a well-defined place in our scheme of transportation. Regular air routes for passengers are now in use in many parts of the country and more routes are being planned. And, in addition to the regular routes, it is possible to charter a special plane for a rush trip to almost any point in the United States.

The Army Air Service is operating a model airway that connects New York, Washington, Norfolk, and Dayton, as well as Detroit and several points in Missouri, Illinois, Oklahoma, and Texas. More than 500 flights have been made. Pilots of this branch of the air service alone carried 349 passengers and 46,707 pounds of non-commercial matter over a distance of 951,130 miles without the loss of a single life!

Commercial passenger lines are already in existence and regularly organized companies are contemplating a transatlantic passenger service that will include the more valuable classes of express matter.

Chambers of Commerce and Boards of Trade throughout the United States are racing with each other in the establishment of suitable landing-fields so that their cities will be included in the proposed routes, for good landing-fields are a prime necessity in airplane service.

IN EUROPE where, for military reasons, each of the more important countries is interested in the development of flying as a matter of national defense, the air routes are subsidized heavily by the governments. This country conclusively demonstrated its disapproval of subsidies when it voted down President Harding's ship subsidy plan, but in spite of the lack of support, development in aviation is taking enormous strides forward.

While refusing to subsidize commercial companies engaged

How America Develops Aviation

in aerial transportation, the United States Government has gone far to advance aviation by the establishment of the Air Mail Service, which transports mail from New York to San Francisco in 33 hours as compared with the fastest railroad mail service, which takes five days to travel from the Atlantic to the Pacific.

OTHER sections of the country have been looking with envious eyes at the superior mail service enjoyed by the cities located on the present Transcontinental Air Mail Route. Los Angeles believes that the western end of the route should be in Los Angeles rather than in San Francisco, while Boston claims, logically enough, that the eastern terminus should be in Boston, with New York as an intermediate point. In the view of Post Office officials, this claim is not so very far from consummation except that Boston would be made the northern terminus of a coastal route, connecting with the westbound line at New York. Under this plan, planes would stop at all of the principal cities along the Atlantic Coast clear down to Florida.

As a matter of fact, air-mail service for all parts of the United States seems to be a certainty in the very near future. Under a law passed early this year, the Post Office Department recently called for and received bids from private concerns to carry the mails on eight important new routes: Los Angeles-Seattle, Salt Lake-Los Angeles, Elko (Nev.)-Pasco (Wash.), New York-Boston, Chicago-Fort Worth-Dallas, Chicago-St. Paul-Minneapolis, Chicago-St. Louis and Chicago-Birmingham.

into Great Transportation System

This up-to-the-minute aerial map of the United States shows the passenger, freight and mail lines, established and proposed, that eventually will link all of our important cities in a vast network of air transportation. Every big city already has made provisions for suitable landing-fields, beacons, and signaling apparatus. In the past four years more than 500,000 passengers have been transported over 12,000,000 miles. Approximately 600,000 pounds of freight have been carried. These figures are based on statistics of established air lines and do not include hundreds of itinerant flyers, the odd-job men of aviation.

This new air service will directly connect 29 important cities with the 16 cities which already have been receiving the transcontinental air-mail service. The eight new routes will mean an extension of the air-mail service for 4662 miles, while the fulfillment of the contracts will require about 390,000 miles of flying yearly on the six round trips per week scheduled for each route.

SINCE the new law provides that private concerns carrying the mails may also transport freight and express matter, it is expected to go a long way in the development of commercial aviation. In view of these advances Col. Paul Henderson of the Post Office Department recently predicted that in 10 years mail planes will be flying not only all over the North American continent, but to Central and South America, to Europe, and to Asia by way of Europe.

The ultimate expansion of the transportation by air of passengers, mail, and freight will be governed, of course, by strictly economic considerations.

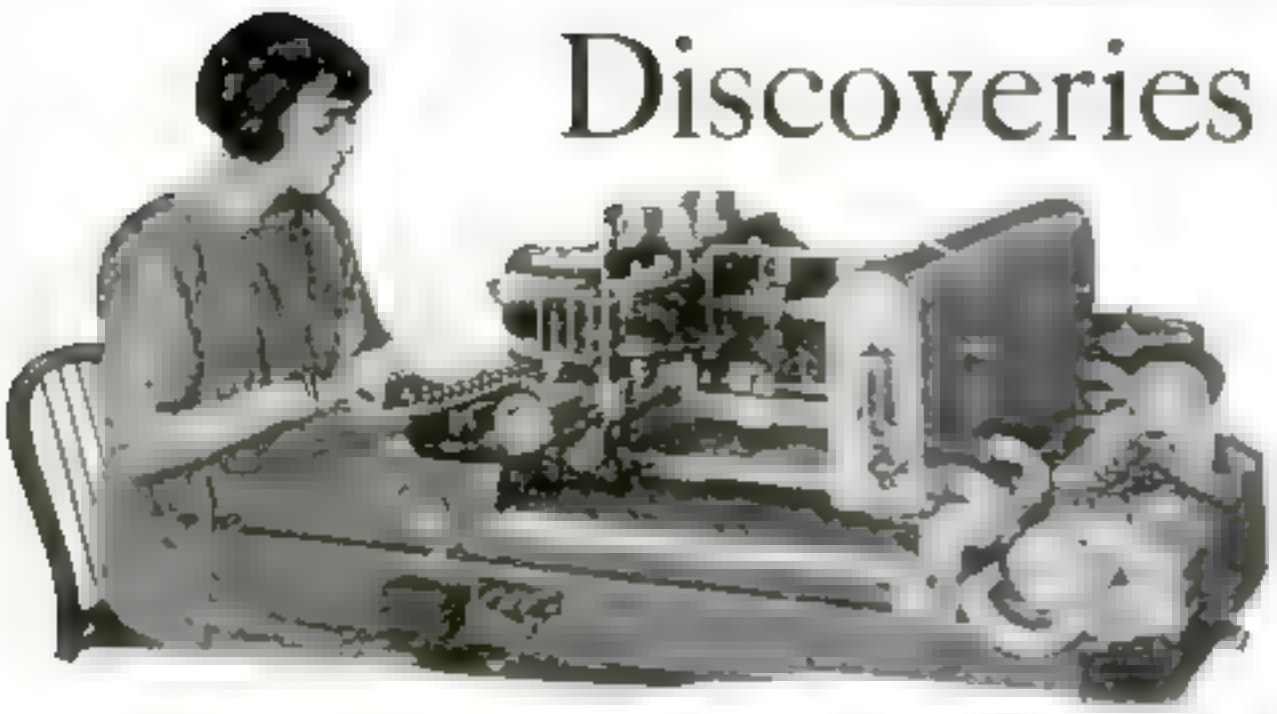
How much will it cost? How soon will it get there? Can I afford to wait? Questions such as these will be the determining factors, just as they always have been in the past. Naturally, they will not be equally important in all cases. With one man, the quick delivery of his goods is the paramount consideration. Another will find that competition has forced his profit down to the point where it is vitally necessary to save every penny, even at the cost of slow delivery.

Undoubtedly, the cheapest known form of transportation is by boats across bodies of water. No railroad can compete with a steamship on a rock-bottom cost or a ton-mile basis.

The reason for this is that the water maintains itself in condition for use as a track for the ship to travel over at no cost to the ship-owner, whereas the largest part of a railroad's maintenance cost goes to keep the tracks and the right of way in good condition. In this respect, the airplane is on a par with the boat, because flying through the air certainly does not wear the air out. On the other hand, the amount of engine power required to keep an airplane in the air is tremendous. A big airplane able to carry only a few tons of freight needs an engine so powerful that it could drive a small tramp steamer capable of carrying hundreds of tons of freight. And the same comparison holds good with the railroad locomotive also

IN SPITE of the cost handicap, however, air transportation is bound to win a big place in the general scheme because it has the one great advantage of extreme speed, and speed every day is becoming more and more the first consideration, both with passenger and freight. The business man who arrives first has best chance at landing an order, and freight that first reaches its destination has the best chance of being sold.

Discoveries that Mark



New Printing Machine Sets Photographic Type

By perfecting a machine that sets type by photography, J. R. C. August and L. K. Hunter, London inventors, claim to have discovered a revolutionary method of printing that eliminates the need of metal type. The basis of the invention is a master film on which letters, figures, and all kinds of type have been photographed. By means of a keyboard resembling a typewriter, characters from the film are projected and printed, one by one, on a sensitized base

Cakes of "Dry Ice" by Mail

SCIENCE has just perfected a marvelous new way to keep ice-cream frozen in its original state for hours at a time without the use of ice. It is now possible to send a pint of ice-cream from New York City to Chicago by air mail, and when the package is opened the ice-cream will be found frozen hard, just as it came from the freezer many hours before!

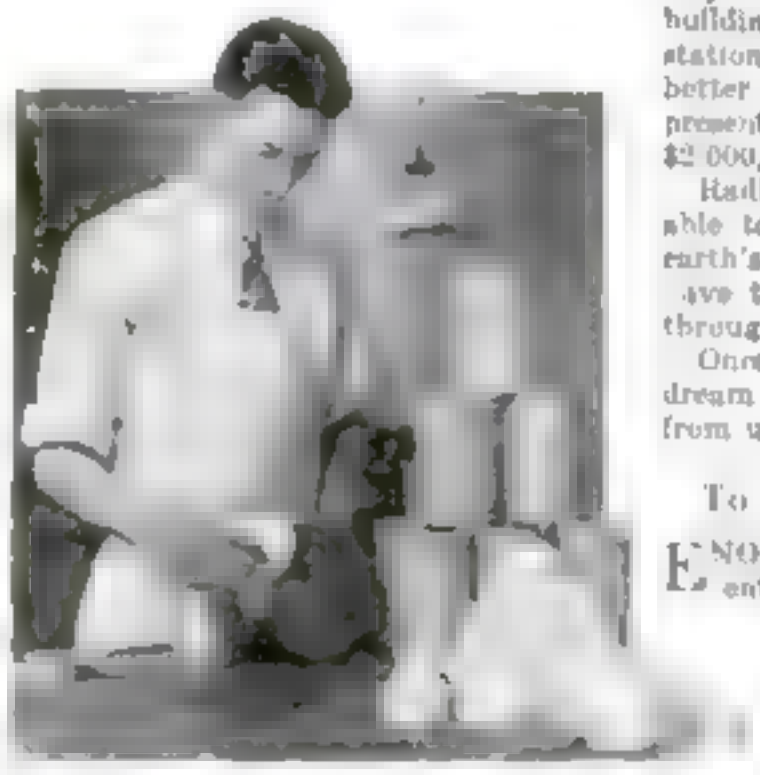
The wonderful material that makes this remarkable feat possible is called "dry ice." It cannot melt. It is perfectly dry to the touch, and yet it is so cold that it will make a thermometer go down to 110 degrees below zero.

You have noticed the small bubbles that form and rise to the surface in a soda-pop bottle when you pry off the cap. This new ice is made out of the same gas that forms those bubbles. In other words, it is carbon-dioxide gas cooled down and compressed until it finally forms a solid, frozen mass.

Solidified carbon dioxide has been produced on a laboratory scale several times, but this is the first application of this queer freezing agent to the preservation of ice-cream. Its use is the result of a long search by a New York ice-cream manufacturer for a method of packing his product in small packages so that customers can take it home and keep it in perfect condition for hours afterward.

Although the temperature of dry ice is colder than the North Pole in wintertime, it may be handled with the bare hands, provided the skin of the fingers is not allowed to touch the solid lumps for more than a second or two at a time. In the ice-cream plant, lumps of dry ice are sent to the packing room, where a workman places a cylindrical piece in a large carton, which also holds a smaller container filled with ice-cream.

The outside container, as well as the one that holds the ice-cream, is made of paraffined cardboard and is, itself, a fair heat insulator, so that the warmth from the outside air penetrates slowly. Instead of heating and melting the ice-cream, the air warms the surface of the block of frozen carbon dioxide and gradually converts the latter back into a gas again.



Packing Ice-Cream with "Dry Ice"

The "dry ice"—small cylindrical blocks of solidified carbon dioxide—is placed in paraffined cardboard cartons that also hold the ice-cream in separate containers

The gas then passes away through a small hole in the outer container, and when it is all evaporated no trace remains to show that there ever was anything in the larger container except the package of ice-cream.

A "Radio Roof" above Us

CENTURIES ago people learned and firmly believed that the starry sky was solid.

Scientists soon banished this illusion, but now in the twentieth century radio experts of the U. S. Navy and the Carnegie Institution assure us that above us there is actually a remarkable "radio roof," an ionized ceiling that deflects waves bumping against it.

Its exact size, shape, and location must be determined through further experiments, but it is known to be more than 100 miles above the earth, where our atmosphere fades into ether. It rises and falls as atmospheric conditions vary.

This roof keeps radio waves traveling around the earth instead of shooting off into the unknown, and it is this that accounts for mysterious "dead areas," according to the experts. Early radio experimenters found that signals could be picked up at distances 40 or 50 miles from where they disappeared. These "skip distances" can now be explained. Horizontal electromagnetic waves sliding off the earth tangently into the sky, meet the radio roof and are deflected, rebounding to the earth 40 or 50 miles from where they left. These skip distances can be checked accurately by means of an exceedingly simple mechanical device.

The discoveries are expected to be of great value in wireless communication, especially in eliminating "fading." The eventual achievement, according to Secretary of the Navy Wilbur, will be the building of a high-frequency transmitting station, costing $60,000, that will give better service and longer range than the present high-power stations costing $2,000,000.

Radio waves such as we know might be able to travel in the ether outside the earth's atmosphere, but first we should have to find a method of forcing them through the ceiling.

Once outside, we might achieve the dream of having them carry messages from us to other planets.

To Harness Tides of Fundy

ENOUGH power to light and heat the entire eastern part of the United States and run all of its factories, is promised by D. P. Cooper, a hydraulic engineer, who recently started a project to harness the tides of the

Tests Safety of Bridges

Morris Berman, young inventor of Brooklyn, N. Y., is shown here with a new apparatus he has perfected to determine exactly the load that bridges can bear. He declares it will give engineers absolute assurance of safety in their plans for future bridge construction

Progress in Science

Bay of Fundy, just off the coast of Maine, near Eastport

He proposes to dam two inlets with giant walls and gates, and control 150 square miles of sea. The tide rises as much as 27 feet. By regulating the outflow, it is figured that from 500,000 to 700,000 electric horsepower would be generated—twice the amount of energy that Muscle Shoals is expected to yield

Mr Cooper's prominence gives the plan to harness the tides of the Bay of Fundy, described completely in POPULAR SCIENCE MONTHLY for May, 1924, new significance. Mr. Cooper helped build the great hydro-electric power plant at Keokuk, Ia., on the Mississippi, and has built hydraulic power stations at Niagara Falls. The Governor of Maine has given his approval to the project, pending the result of a state referendum.

Organ Tones for the Piano

IN HIS cottage in Gloucester, Mass., before an audience composed of some of the world's most famous musicians, John Hays Hammond, Jr., a well known inventor, recently gave an amazing recital He demonstrated for the first time an invention that practically turns the piano into a pipe organ. Professional musicians have declared it the most remarkable improvement that has been made in the piano since it was evolved in the eighteenth century.

Ordinarily, when the keys of a piano are struck, no matter how hard, the tones fade away gradually. Mr. Hammond's invention permits the player to control the tones, either sustaining them, letting them grow, or die. Reflectors set inside the instrument, controlled by a fourth pedal, made it possible to build up a tremendous sonority. These reflectors are parallel revolving slats that are opened or closed by the action of the pedal. They cause the sound to rebound to the sounding-board. The volume of tone depends on the angle at which the reflectors are set by the pedal

In exterior appearance the piano is little changed, except that the case is slightly deeper. The fourth pedal is used automatically just as the expression pedals are. A means for adapting the system to player-pianos has been worked out also.

A Revolutionary Piano

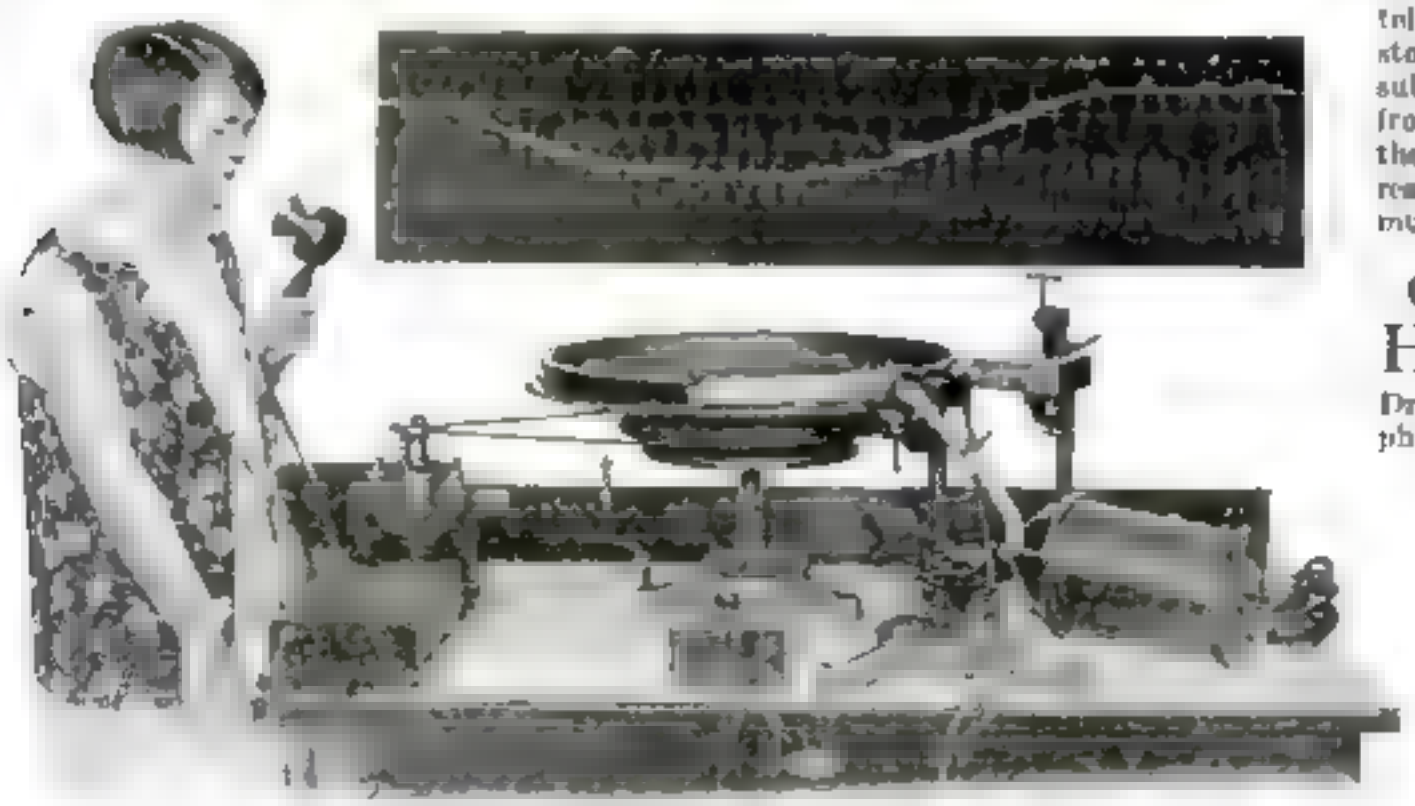
John Hays Hammond Jr. left demonstrating his remarkable new invention that gives organ tones to the piano. At the right is Lesue Buswell, his assistant

Radio Waves from the Brain?

A CERTAIN group of believers in mental telepathy have been asserting for years that when we think, the brain sends out actual waves. These are carried through the air, they say, and may be received and understood by another person whose brain is attuned to the particular wave length transmitted

Professor Ferdinando Cazzamali, an Italian scientist of the University of Milan, has just finished some unique experiments which, he says, give this theory a scientific basis. When our brain radios are understood fully, he declares, we shall have a new method of sending messages far superior to wireless telegraphy

He experimented with highly excitable persons suffering from mental ailments. He put isolated men and women in an insulated cabinet, hypnotized them, stimulated their mental faculties, and listened to the reactions through a wireless headpiece attached to his ears. He declares that he heard waves similar to radio-telegraphic transmission sounds, which stopped immediately upon waking the subject. The waves varied in length from four to 10 meters. Sometimes the sounds were accentuated until they resembled whistling or the tone of a muted violin.



Singers' Voices Photographed and Analyzed

The voice of a singer or speaker now can be photographed and analyzed by means of this remarkable machine recently constructed at the University of Iowa. The inset shows a record of the sounds produced by the singer at the left. Vibrations set up by the sound waves actuate a delicate mirror device that flashes a point of light on a rapidly moving film, giving a complete chart of the sound waves

Candy an Aid to Runners

HAVE a chocolate, college athlete. Experiments made recently by Dr. Burgess Gordon and other Boston physicians contradict hard-hearted trainers who forbid candy.

Marathon runners were placed on high carbohydrate diets before the races, besides being supplied with candy and over-sweetened tea. Blood tests taken after the races showed far less exhaustion than was true of the same men in previous marathons. There was striking improvement in their general physical condition, the physicians declared, and the athletes made better running time than those who had not eaten chocolate.

Men Who Have Made

And Others Who Have Found Happiness

He Wields a Mean Brush

When he is not wielding the baton Walter Damrosch, famous conductor of the New York Symphony Orchestra, delights in swinging the paint brush at his country home at Bar Harbor, Me. His is just the common garden variety of painting, but he can stain a chair or coat a barn with the enthusiasm of a real artist

Explores the Sea

Lured by the mysteries of the deep sea, Dr Hans Hartman (left), American engineer, is heading an expedition into the Mediterranean in search of buried cities. He has invented a diving cylinder in which he expects to explore sea depths of from 5000 to 15,000 feet

Plays with Glass

The hobby of reproducing famous stained glass windows is an inherited passion with Jacques Simon, a French artist (below). Now he is matching colored glass for windows in the restoration of the war damaged Rheims cathedral in France

Talking Is His Sport

Just for a pastime, Herr Horaz, German actor, stands on Berlin streets and endeavors to prove he is the most long-winded talker in the world. He has talked 20 hours and soon will try for a non-stop record of 48 hours, he has just announced

Champion Picker

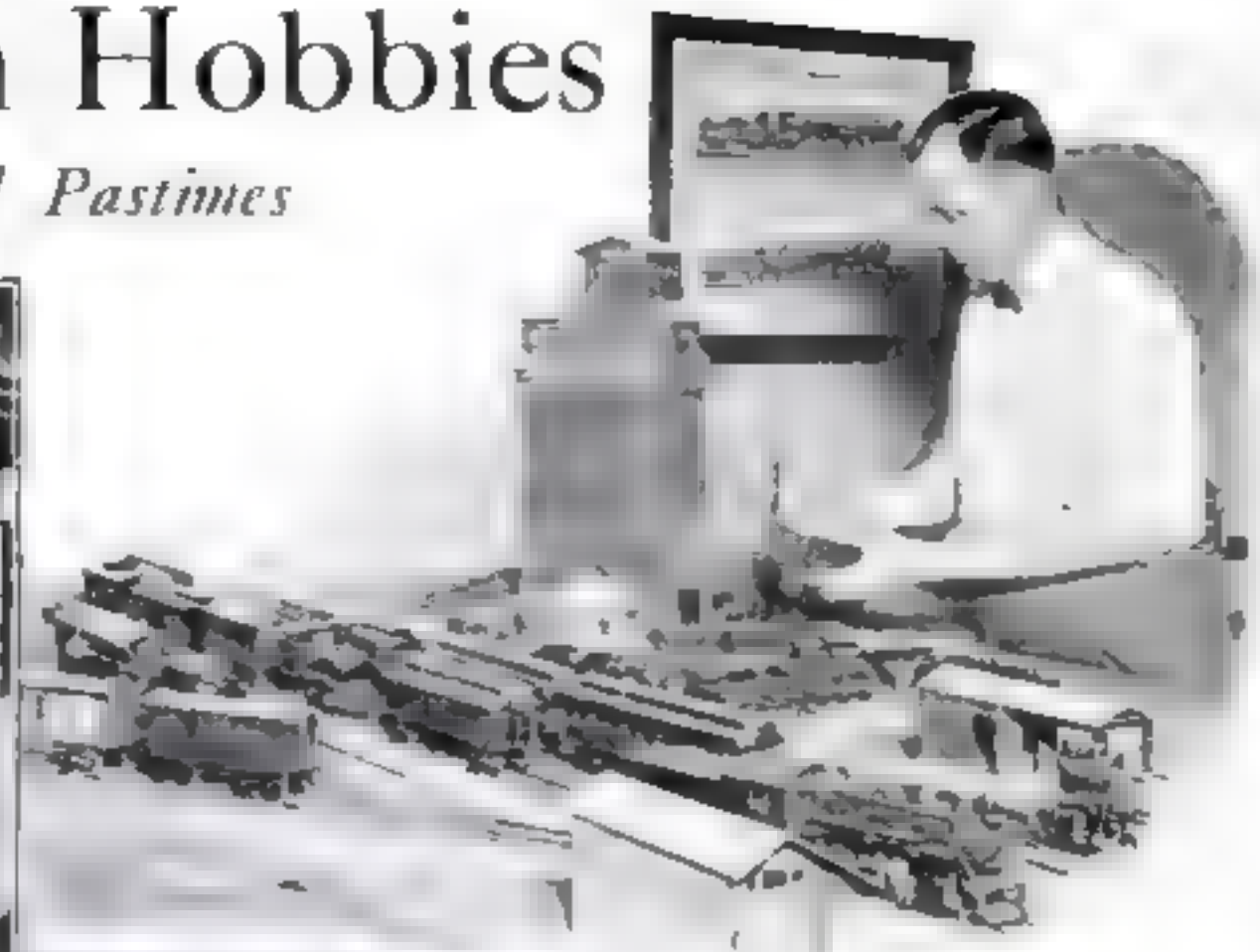
Picking blueberries is recreation for Richard W Sullivan (right), of Washington County, Me. He holds a record of 20 bushels a day, gathering the fruit with the aid of this ingenious rake

Good with Hobbies

and Profit in Unusual Pastimes

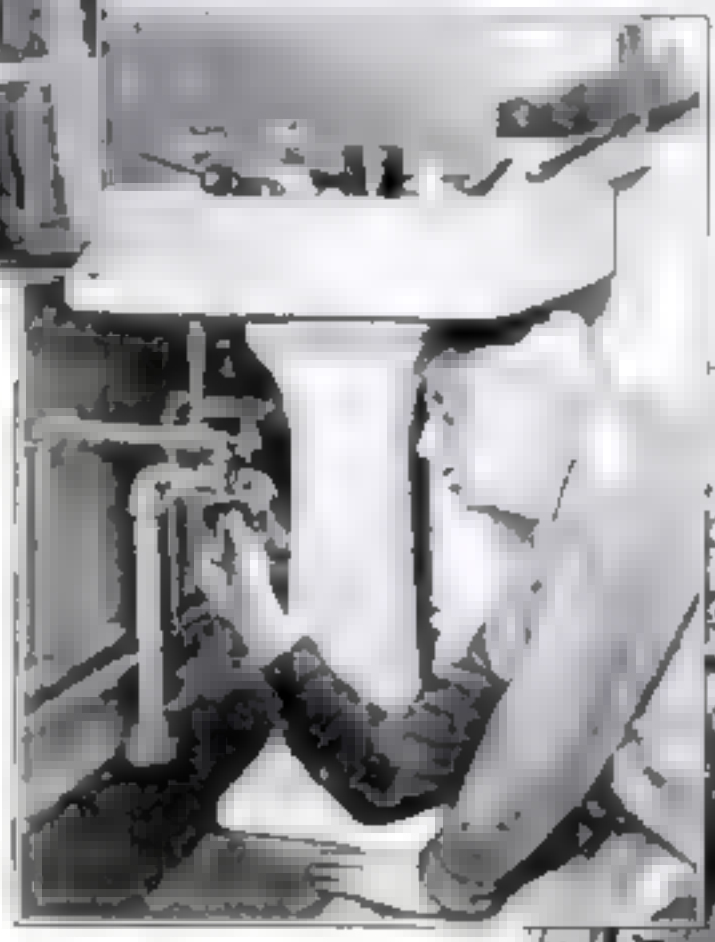
No More Scorching

Martin C. Berated, of San Diego, Calif., grew tired of seeing scorches on his shirt front, so in his spare time he invented a fire-proof electric iron that turns off automatically when a certain temperature is reached, then turns on again as the iron cools



Plays with Toy Trains

For more than 20 years J. N. Swartzell, permanent business man of Washington, D. C., has devoted all his odd moments to the creation of a miniature railway system. Each one of his model locomotives and cars is said to be mechanically perfect



His Own Plumber

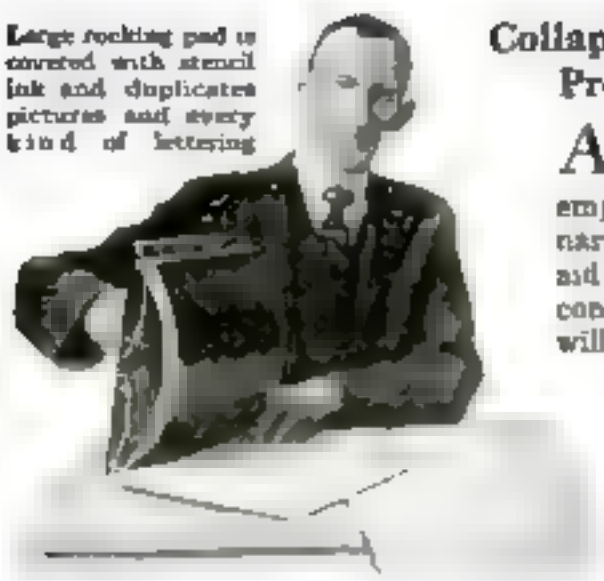
Frank Hedley, head of New York's subway system, prefers tinkering at odd jobs about his home at Green's Farm, Conn., to playing golf for recreation. The picture at the right shows him repairing the plumbing

A Wayside Pottery Maker

Jacob Dvorsak, a native of Jugo-Slavia, discovered a bed of clay on his little farm near Spokane, Wash. He built a kiln and now when the chores on the farm are done, he sells odd pieces of pottery at the roadside. The picture shows the variety of patterns he achieves

Young Pershing an Auto Mechanic

When not attending school near Lausanne, France, Warren Pershing, left, 19-year-old son of General John J. Pershing, spends his vacation as a mechanic in a Paris automobile assembly plant where he will learn all about motor-cars



Large rocking pad is covered with stencil ink and duplicates pictures and every kind of lettering

Cartoons, Typing, and Print Reproduced by New Device

DUPLICATING posters and cartoons simply and neatly is one of the many uses of a new device reproducing typewriting, handwriting, or pictures, on bond, tissue or ordinary papers, cardboard, or from blocks of metal.

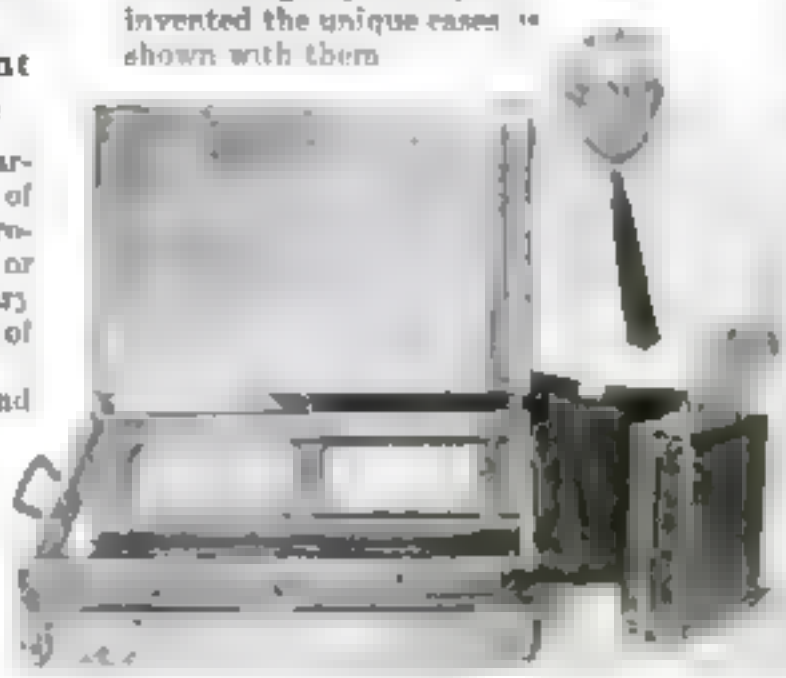
It works with a rocking motion and has the shape of an arch with larger radius than that of the common type of cylinder duplicators. The ink pad has a base of very fine wool, covered with a closely woven fabric and is claimed to do the work without smearing. Stencil ink is applied in the ordinary manner and ordinary stencil papers are used. The machine is made in three sizes.

Collapsible Egg Crate and Packing-Box Proves an Economical Invention

A COLLAPSIBLE packing-box and egg crate that may be sent back to the shipper when empty, while costing more at first than the ordinary ones, is declared to be economical and an aid in the conservation of lumber. The larger container in the photograph is 17 inches deep and will collapse to a depth of 6¼ inches, while the small one, 12 inches deep, will collapse to a depth of four inches.

The two containers pictured below have seen five years of hard service on the railroads, and are said to be still good.

Adolph Von Schluembach, of Washington, D. C., who invented the unique cases shown with them



Crate and box folded into three times less their open size

Doctor Says Anesthetized Patients Do Not Talk

PERHAPS you are one of those who dread taking an anesthetic in the dentist's office or operating-room because you might say things in your sleep Doctor Floyd Troutman, an anesthetist, says that this fear is groundless. Under modern methods of administering anesthetics, he explains, consciousness is lost so rapidly that the patient does not have time to say anything. And on coming to, he usually is so drowsy that he hasn't the energy to talk.

Fingerprint Pad Is Carried in Depositor's Check-Book

FINGERPRINTS, surest method of identification yet discovered, now may be used on checks for protection against fraud. A compact outfit for this purpose slips into your hip pocket or purse

One pad holds the ink, while another contains a cleaning cream for removing the ink from the finger or thumb after the mark is made.

The owner may place his fingerprint anywhere on the check. When the check-book is closed, a cover fits flat down over the pads. The fingerprints of depositors are kept on file in banks where this system is used, just as lists of signatures are kept in other banks.

U.S. Government Breeds Bugs to Test Insect Powder

IN A strange nursery on the banks of the Potomac, the U. S. Government keeps a host of fleas, mosquitoes, mites, and flies. When fully grown, they serve to test poisons that are sold throughout the country for extermination of insects.

Among the most valued assistants on the bug farm are four dogs, two cats, and 125 chickens, who produce bumper crops of fleas and mites. To get first-hand information on whether advertised mosquito and chigger preparations do all that they should, a human worker in the laboratory daubs the stuff on one arm and spends the afternoon fishing on a chigger-mosquito infested bank.

Know Your Car

THE wheel bearings of an auto require very little attention. For this reason motorists are inclined to take the condition of the wheel bearings for granted. But complete neglect usually means a repair bill and sometimes a bad accident.

Properly cared for, the wheel bearings will outlast the other moving parts of the car. You can keep them in good condition by following these rules:

1. Thoroughly clean all wheel bearings at least once every 5000 miles. Be sure to remove all of the old grease. Gasoline or kerosene should be used for cleaning.

2. Examine the surface of each ball with minute care and discard any that show even the faintest sign of a crack

3. Replace broken rollers or balls with new ones only after you have made certain, by the use of a micrometer, that the new parts are precisely the same diameter as the other balls or rollers in the bearing.

4. Reassemble the bearing and pack it carefully with a high grade of soft cup grease.

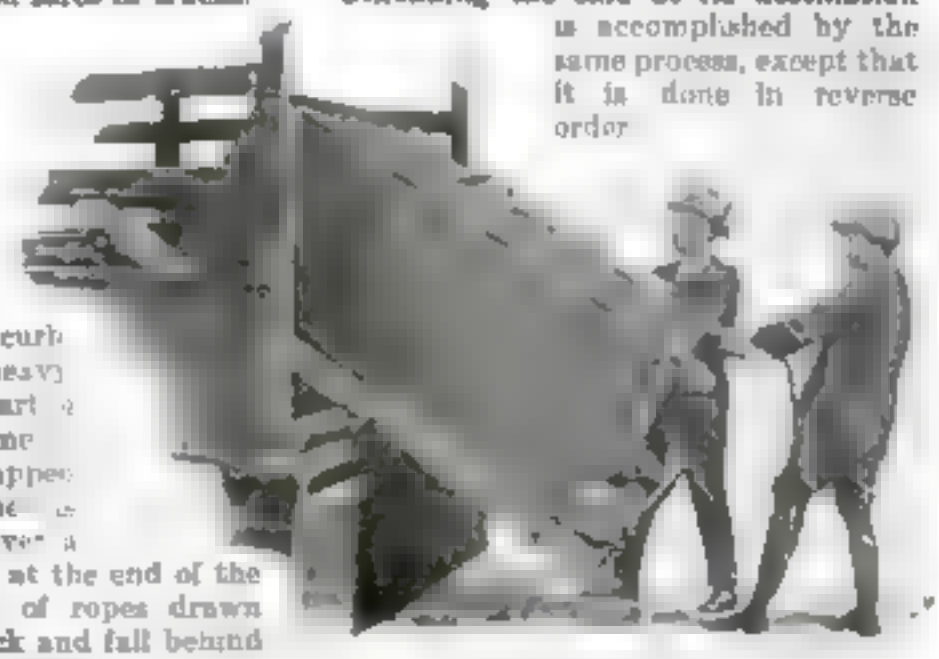
5. Adjust the ball bearing so that it will turn freely without perceptible play. Set the roller bearing so that there is just perceptible play.

Safe-Moving Device Saves Dangerous Labor

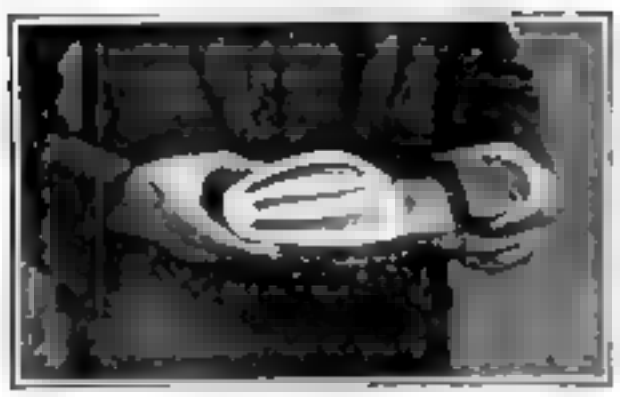
EXPERIENCE had taught John A Wagner, of Baltimore, Md., how hard it was to load and unload safes in trucks. He lessened the danger of this moving job by inventing a device that puts rollers, block, and tackle to work instead of muscle.

The safe is slid on a platform that is even with the top of the street curb Its rear wheels rest on a heavy steel ledge, the bottom part of an upright carrying frame which the safe is strapped securely The frame then is tilted back and slides over a long roller that is set in at the end of the truck. With the help of ropes drawn through a winch or block and fall behind the driver's seat, it is pulled up until it rests on its back in the truck, ready for the trip.

Unloading the safe at its destination is accomplished by the same process, except that it is done in reverse order



Placed on platform, safe is rolled on truck



Scotland Sends Us Shoes with Aluminum Gripper Soles

THICK Scotch mist was responsible for the invention of gripper aluminum soles for golf shoes. The links in Scotland get very wet on misty days and a Scottish sportsman hit upon the metal sole idea to keep his feet dry.

The soles are fastened to the shoes by 10 tiny nails or screws, and afford the feet a firm grip on the ground. In the largest sizes the soles weigh less than two ounces and they are claimed to be strong enough to last a season.

Hunters tramping over damp ground, or those engaged in work that takes them out in all weathers might find the soles equally useful

Dead Sea Products to Enrich Palestine

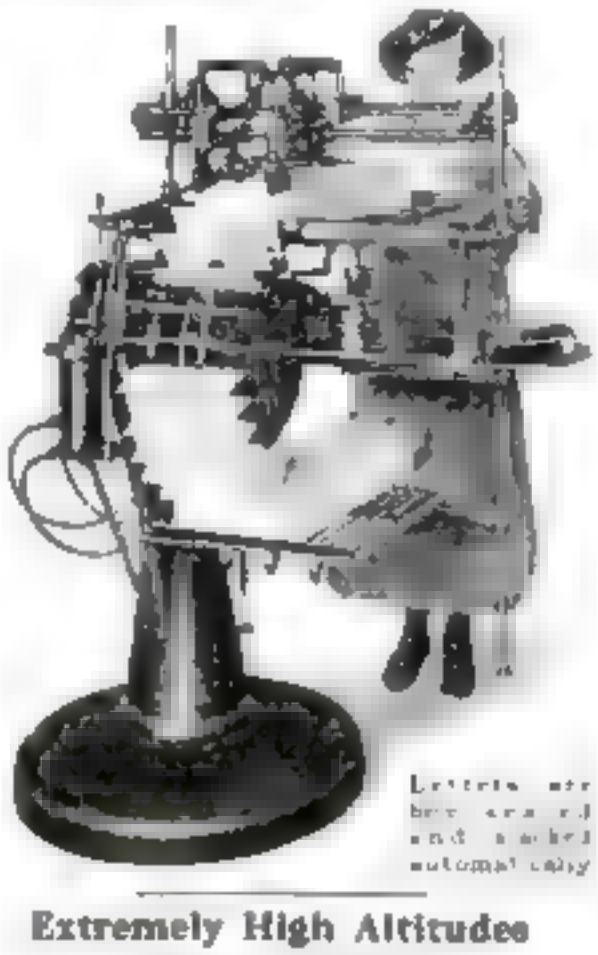
RICHES in the Dead Sea soon may make of Palestine a land of plenty. Rights of exploitation of the vast quantities of chemicals in it recently were offered for sale.

The supply of potash in the waters is considered inexhaustible. Common salt would be obtained in such tremendous quantities that the problem would be how to get rid of it. It might have to be dumped back into the sea after more valuable salts had been extracted from it. The salts will be extracted by a system of evaporation and crystallization that is very rapid, on account of the stifling heat in the Jordan valley

Transportation from the Dead Sea to the Mediterranean is the greatest difficulty foreseen

Automatic Sealing Machine Does Away with Hand Labor

A WHOLE row of girls, all working at top speed, could not beat this novel sealing machine. It is designed particularly for use on advertising folders and other pieces of advertising matter that are sealed by means of a gummed sticker The folders are stacked up by hand on the upper table, and the machine, after sealing them, stacks them in neat piles on the lower table.



Letters are [illegible] and sealed automatically

Extremely High Altitudes Slow Up Action

BECAUSE he believes that living at high altitudes is dangerous, a French scientist took a healthy young squirrel in a cage to the top of Mont Blanc for experimental purposes recently. The cage had a revolving wheel in it that registered every turn and that the squirrel was able to turn 6500 times every 24 hours at a low level, but only 900 times in the same period of time at the top of the mountain

Novel Invention Makes Every Cop His Own Signal Tower

RECENTLY Clarence A. Rich invented an ingenious strap and electric-light apparatus, to be fastened around the hands of traffic policemen so that their signals to motorists and such can be seen at night.

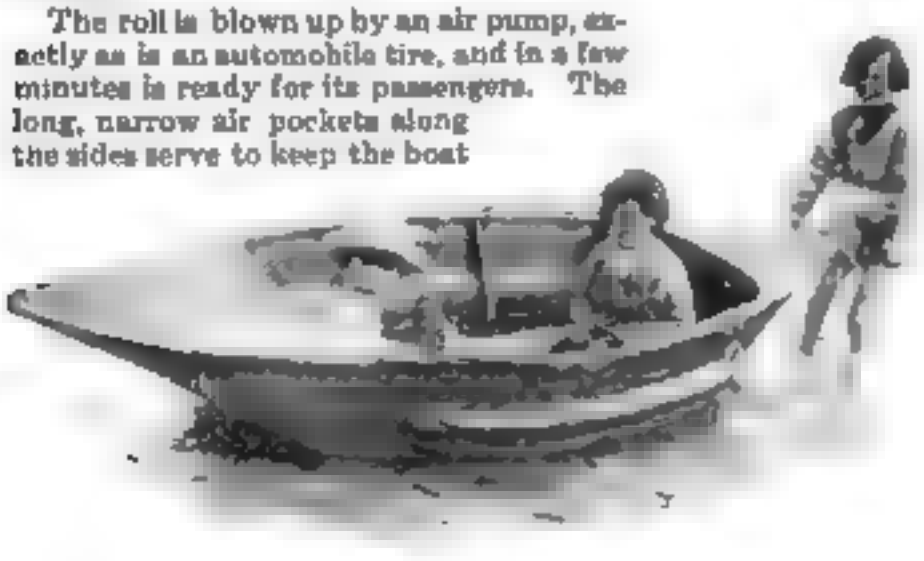
The red, green, and yellow lights of the usual traffic towers are reproduced in miniature for the policeman's hand signals, which are on the palms and the backs, not too bulky to be cumbersome.

Above is shown Traffic Officer Prendergast, of Swampscott, Mass., using the new signaling device. It was at Swampscott that the President and Mrs. Coolidge spent the summer, and where, consequently, due to many visitors, traffic was particularly heavy.

Children's Boat Is Inflated like a Tire

THE children want a boat ride or father wants to go duck shooting and out comes a small fabric roll packed away in the automobile or carried on the back the same way that a knapsack is carried

The roll is blown up by an air pump, exactly as is an automobile tire, and in a few minutes is ready for its passengers. The long, narrow air pockets along the sides serve to keep the boat on an even keel, and make it reasonably safe for children to ride in in shallow water, where there is no strong current.



Toy boat is balanced by air pockets at each side

A TREMULOUS earth means a young one, explained Prof. Charles W. Brown, a geologist of Brown University, Providence, in a lecture recently at Montreal. The series of earthquakes on the Atlantic and Pacific seaboards this year are mere evidence of growing pains, according to Professor Brown. When the earth finally gets adjusted and settled in old age, there will be no more quivers.

How Much Do YOU Know about Science?

THESE questions are chosen from the many that come to POPULAR SCIENCE MONTHLY every day. Look them over and see how many you can answer. Although the questions concern things that we all frequently encounter, it is surprising how many new and interesting facts they reveal about the world in which we live.

After you have finished, turn to page 160 and see how many of the 12 questions you were able to answer correctly.

1. Why does gas form in cider when it ferments?
2. Which was the first animal to be domesticated?
3. What are kilocycles?
4. Are men growing taller or shorter?
5. Do we need to be afraid of falling stars?
6. Can we make water boil without heating it?
7. Why is it that when you are hit in the eye, it becomes black?
8. How do artificial rubies differ from genuine ones?
9. Why are the walls of a building usually blown outward by a tornado?
10. Have scientists succeeded in changing the sex of an animal?
11. Is electricity produced by our own bodies?
12. How is the brain fed?

How They Figured the Thing Out

Ingenious Plan to Prevent Traffic Jams

To solve the problem of traffic congestion at a busy square in Berlin, Germany, City Architect Mulberg devised the novel system of elevated radiating walks for pedestrians, shown in the model above. At the center of the elevated platform is the entrance to a subway

Locomotive Steam Used to Kill Weeds

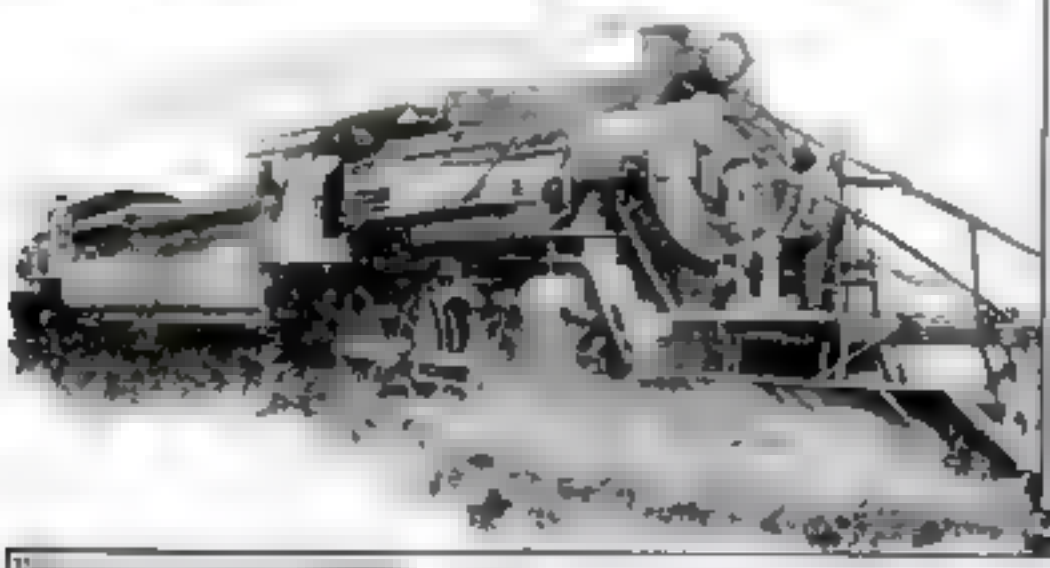
The Atlanta Birmingham Railway was bothered with weeds along its tracks until an engineer thought of using steam from locomotive tanks. Pipes run from the boiler to a steel sprinkler in front

Soda Tank a Fire Bell

Garretson Beach, near Sheepshead Bay, N. Y., had a volunteer fire department but no fire bell, until a few weeks ago, when a firemen thought of using an old soda water tank from the drugstore

Saves Hard Labor

A Frenchman who had to move heavy furniture from upper floors, recently devised the apparatus at left. An adjustable metal pole fits tightly between the top and bottom of the window frame, and holds a swinging arm to which the furniture attaches by a pulley



Lifting a steel bridge twenty-three and one-half feet —enough to allow a ditching dredge to pass beneath—was a recent accomplishment of engineers near Sullivan, Ind., with the aid of two locomotives. Timber towers were erected at each end of the bridge to support block and tackle with which two locomotives, pulling from both sides, raised the 100-ton bridge bodily while the dredge passed through

Experts Who Work at Queer Jobs

Carves Birds in Ice

From rough blocks of ice, Nino Angelo, celebrated ice sculptor of the Hotel Victoria, London, carves marvelous animals, birds, and fishes to be used as centerpieces. He is shown completing an ice model of a swan, which took about one hour

A Tamer of Crocodiles

Captain H. Wall, former German sea captain, has the distinction of being the only man in the world to succeed in training crocodiles. He exhibits his trained pets in the circus the year around

Makes Lures for Anglers

Twenty years of her life Mrs. Elizabeth Hecht (right) has spent making fishing tackle, tying flies and designing lures. She is superintendent of fly making in a large bait factory at South Bend, Ind.

Washing Big Ben's Face

Keeping clean the face of Big Ben, the famous Houses of Parliament clock in London, is James Gordon's job. Here he is shown with an assistant hard at work 300 feet above a London street

Champion Helmet Maker

John Plovak (below), a native of Greece, is considered one of the world's greatest diving helmet makers. Yet he never has worn one of his creations. His shop is on the banks of the Anclote River, Florida

How Would You Like This?

P. D. Buckley sits atop the New York Edison Company power plant every day and watches the color of smoke and gases that issue from the giant smoke stacks. These observations are made to determine the highest attainable efficiency in coal combustion. Buckley's job probably is the only one of its kind in the world—and he likes it

Is a New Ice Age *Approaching?*

Amazing Prophecies, Great Achievements, and New Discoveries Set Pace in Science

World's Longest Telephone Cable Completed

F. A. Stevenson of the American Telephone and Telegraph Company is seen here making the last splice in the world's longest telephone line: an 861-mile cable connecting New York and Chicago, and furnishing express telephone service practically free from hazards of storm damage. The event took place recently at Swanton, Ohio. The mammoth cable will be able to carry 250 telephone conversations and 500 telegraph messages simultaneously

So swift is the wonderful progress of science that the busy man often finds it difficult to keep informed of the new developments or to grasp their significance. That you may keep pace with the march of science, the news of some of the outstanding achievements of the month is presented here in concise form.

SOME 20,000 years ago, toward the close of the great Ice Age, Europe was a country of bleak, treeless plains, much like Siberia or northern Canada of today. Wandering, primitive men lived on herds of reindeer and wild ponies that roamed the plains. Towns, villages, and farms were unknown.

Will history repeat itself, with another Ice Age like the last one? Will the present European civilization vanish?

The startling prediction that Europe is drifting nearer and nearer a new Ice Age was made recently before the South African Association for the Advancement of Science by General Jan Smuts, former Boer commander, British general during the World War, and later Prime Minister of the Union of South Africa. He placed the advent of the new age at 10,000 years from now, although, he predicted, long before that time European life will have altered beyond recognition by people living in our day.

The climate of Africa, he added, also will become gradually cooler, moist, and rainy, with the result that the present stretches of wilderness will pass away. In all probability, he said, our present human races will have disappeared before this next phase, giving place to higher species.

Predicts Aerial Cities

AN AMAZING picture of future cities built far above the earth on platforms reached by tower elevators is presented by Frederick Kiesler, a prominent young Viennese architect. In these days of airplanes, it is absurd, he thinks, that we still should be crawling around on the ground and burrowing into it to make dwelling places.

Distance is nothing. We can live anywhere we like, so why not in the freshest air obtainable? He predicts that houses in the future will be built on platforms supported by steel girders several hundred feet above ground. They will be erected above beautiful gardens, shady forests, or even above lakes or the sea. Platforms will be provided, too, for landing places for airplanes, he believes.

A New Star Discovered

AS HE walked home in the early morning, a telegraph operator in South Africa had a habit of studying the starry sky. One morning he was startled by seeing a strange star in the constellation Pictor, and the idea struck him immediately that it must be a new one. He verified his discovery after breakfast, then telegraphed to the observatory at the Cape of Good Hope, which announced it to the world, one of the most noteworthy astronomical events in months.

The new star, known as "Nova Pictoris," is especially interesting because it is the first one discovered long before it reached its maximum brightness. Before its outburst this star was an insignificant looking specimen of the fourteenth or fifteenth magnitude. At its maximum, it became 400,000 times brighter, and shone as a star of the first magnitude

Finds Matter "Empty as the Sky"

Matter is only a vacuum, "as empty as the sky" in which there are countless electric charges, according to Dr. W. R. Whitney, Director of the General Electric Company Research Laboratory. He is seen here using the latest apparatus for studying uranium atoms

Ancient Maya Cities Found

COMING out of the jungles of Mexico and Guatemala, the first Tulane Middle American Expedition returned recently, reporting one of the most astounding series of archeological discoveries ever made by a single expedition. In six months of nerve-racking hardship the explorers located three huge centers of Maya culture, each consisting of a cluster of ruined cities, containing a tremendous quantity of monuments carved with dates and hieroglyphs.

Like Columbus, who carried an Indian back to the Old World, they brought with them Tata, a pure descendant of the ancient Maya Indians. They are hoping he will divulge some of the secret customs and rites of his famous ancestors. He cannot speak a word of English.

In one ancient city, the explorers discovered the first real astronomical observatory of the old Mayas to be unearthed. Here mounds and pyramids had been constructed in such relative positions that priests could ascend the main mound and, sighting over three mounds in the foreground, make scientific, astronomical calculations. In this way they could tell when eclipses of the sun and moon were due to occur. They used this knowledge to wield power over the Indians.

Man-Made Hurricane

TO DRIVE out the poisonous carbon monoxide produced by 46,000 autos that will pass daily through the new vehicular tunnel nearing completion beneath the Hudson River, a tearing hurricane

will whirl constantly through the tube. A unique system of ventilation approved recently solves the last important engineering problem of the great tunnel.

Immense electric fans will drive a 75-mile gale through a seven-foot airway under the traffic road. It will reach the road through slots and be dispersed by a baffle plate. The used air will be sucked out through ceiling vents and will enter another immense airway leading back to four ventilation houses, two on each side of the river, where will be located the machinery for taking in and expelling the air

New Process Hardens Lead

WHAT generations of scientists have tried to do since the days of early Egypt and failed, has at last been accomplished, it is reported by the Western Electric Company. A method has been found to harden and temper lead. R. S. Dean and W. E. Hudson, of Chicago, metallurgical engineers, discovered the process largely through accident.

A small percentage of alloy is used and the metal is treated by a special heating process that results in a metal three times as hard as ordinary lead. One of the uses for the new metal is sheathing for telephone cables

Monkey Farm for Research

TO FIND out the truth about man and monkey—just how much monkeys actually resemble men in their growth and habits, Johns Hopkins Medical School in Baltimore has just established a monkey farm, where the animals will be studied intensively

Hitherto, most of the monkeys with which scientists had to work were dead ones brought back from expeditions to the East. But the hunters knew nothing about the history of the animals they shot. On the monkey farm it will be possible to keep track of each specimen, its age and diet, so that an animal may be taken for study at any stage in its development.

Comparison of monkeys with human embryos is expected to give important evidence of their relationship. A very close watch will be kept on the social life of the animals. Investigators will try to discover the reason why so many monkeys die before birth —a discovery that may be very useful to man.

Flame in Water

SUBMERGED in water, an oil flame invented by a Belgian scientist, Oscar Brunler, will burn for weeks without going out, it is claimed, and so avoid most of the heat loss of an ordinary boiler. A device similar to a carburetor blows a spray of crude oil mixed with air into the burner under pressure. Water is kept out of the burner until the flame is well started, then allowed to rise around the flame and cover it.

In all boilers loss of heat is avoided by bringing the flame of the fuel into the closest possible contact with the water The Belgian inventor is said to have obtained almost perfect efficiency by putting the flame directly in the water.

Synthetic Insulin Made Possible

Bulk production of synthetic insulin for the cure of diabetes is promised through the work of Dr E M K Geiling associate professor of pharmacology at Johns Hopkins University Baltimore and Dr John J Abel Here is Doctor Geiling experimenting with the new insulin product in his laboratory

A Dog without a Bark

A BARKLESS dog emerged from a clinical demonstration conducted by the American Veterinary Medical Association at Portland, Oreg., recently. The barking apparatus was removed as easily as tonsils, the veterinarians declared. Such an operation, they say, would be the means of saving the lives of thousands of dogs who make intolerable nuisances of themselves by constant barking

Serums for Snake Bites

WITH enough rattlesnake venom to kill the entire population of a big city, Raymond L. Ditmars, curator of reptiles of the New York Zoological Park, left recently for Brazil. The quart of venom he carried represented the production of 2500 snakes since early spring

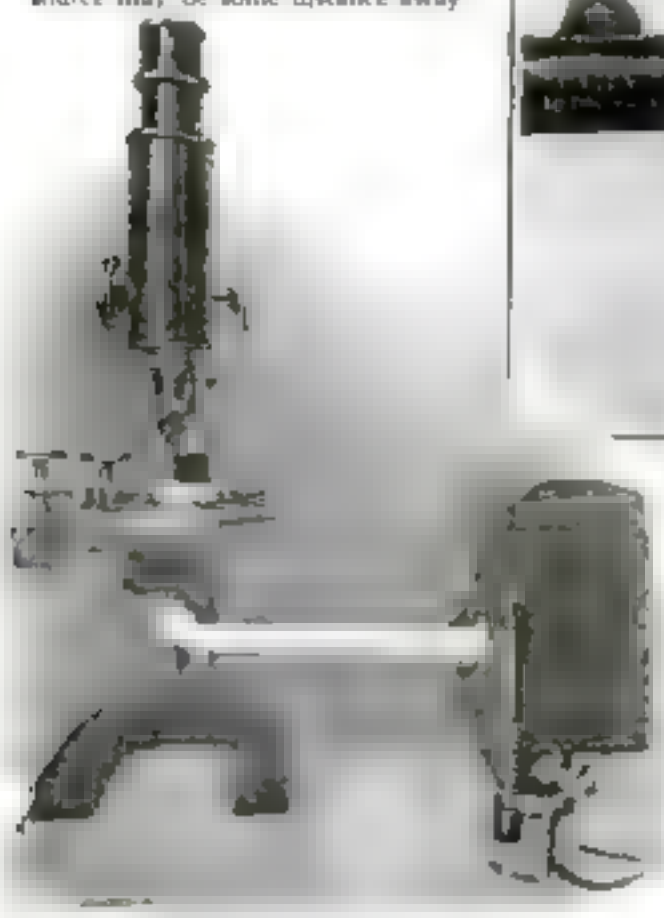
It will be used in the manufacture of serum to combat snake poison, a process that is developed much further in South America than in the United States. The venom first is injected in horses, which produce the protective serum.

More than 100 persons die every year in the United States from snake bites, Mr. Ditmars explained, and the supply of serum from South America, given out free by the zoo last year, was insufficient. To be most effective the serum should be made from the venom of the same kind of snake against whose bite it is to be employed. On his South American trip Mr. Ditmars hopes to obtain serum specifically for use against the bites of North American snakes. If given an injection of the serum within an hour after having been bitten by a snake, any one will recover almost completely within 24 hours, Mr Ditmars says.

The August issue of POPULAR SCIENCE MONTHLY described the interesting method by which Mr. Ditmars' quart of snake venom was collected.

A Remarkable Microscope

New secrets from the world of the infinitely small soon may be revealed through a new method of illumination for microscopes, using rods of clear [illegible] glass. In the apparatus pictured below the light is conveyed through a [illegible] quartz rod without being absorbed so that the light source may be some distance away



Before the Bullet Emerged

The remarkable photograph above shows the muzzle of a 45-caliber [illegible] has been fired and before the bullet emerges [illegible] taken with a new electrical timed apparatus recently perfected by Philip P Quayle, of the U. S Bureau of Standards which makes it possible to [illegible] the release of gas and sound waves from weapons and throws new light on the theory of ballistics The heavy circle seen in the photograph is a sound wave

Woman Invents Household Budget Machine

Demonstrating the new budget machine

IT'S all very well to say "keep a budget." But when it comes to figuring out just exactly how the dollar should be split, the average housewife gets dizzy.

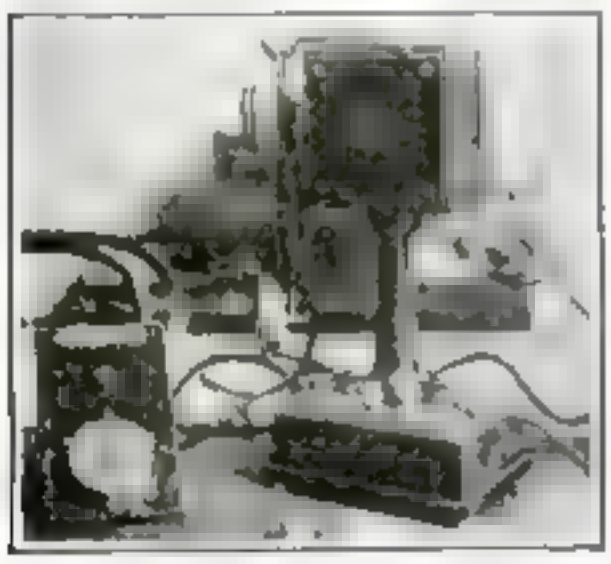
A whirling device, invented by Mrs. Annie Peaks Kenny, of Chicago, adapts itself with a surprising flexibility to the changing needs of the budget keeper. An electric motor turns various sets of figures on a revolving drum so that they appear in a window next to a list of stationary captions of the main class of expenditures.

As conditions alter—for instance, if the family becomes larger—the arrangement of figures changes. The whirling has a range of from one to four persons and handles incomes from $100 to $1200 a month.

Instrument Registers Telephone Calls Automatically

NO MAN ever really is satisfied that he has not been charged for more telephone calls than he has made. This simple apparatus, launched by a French inventor, makes the checking an easy matter.

An automatic register is adjusted to the telephone instrument. After each call you press a button and the machine does the rest. At the end of the month you read off the figures in the slot. It is arranged for a four-figure number, which meets requirements for most telephones.



Arrow points to telephone register

Shoes Respond to Changes in Weather Conditions

GRANDMA says that it is going to rain, and it does. How did she know? By her corns. Isn't that wonderful? No, not particularly, for scientists have just pointed out a direct connection between shoes and weather. Changing amounts of moisture in the atmosphere cause leather to shrink or expand with corresponding degrees of comfort for those with tender feet.

Some leathers are much more comfortable than others, for they are more porous. Feet must breathe, and if the shoe leather is loaded with finishing materials, oil or wax, it will not admit enough air to evaporate foot perspiration. Patent-leather shoes keep perspiration in and air out. If they could be worn with the shiny side in, they would be three times as comfortable as with the shiny side out.

Piano Ashtray Ends the Smoker's Dilemma

ASHES on the piano keys—it's a way to incite the wrath of any wife. Smoking doesn't go with piano playing, yet it is done, and the instrument is so peculiarly built that there is no convenient place to set an ashtray.

A new tray, invented by Dr. Charles A. Greene, of New York City, clamps on the edge of the piano as shown in the above picture. It is padded so that it will not mar the finish and may be fastened on thicknesses varying from half an inch to three inches. It will clamp also on tables or arms of chairs and has the added advantage of not tipping over unexpectedly.

Improved Tin Can Has Shiny Aluminum Lining

PRESERVES and fish put up in tin cans commonly tend to turn the inside of the can black. While this is not harmful, and the food itself is not discolored, yet the blackened metal causes some persons to mistrust the food. Lining the can with paper prevents the blackening, a method that is used quite generally in packing fish.

A French inventor has devised an improvement on this by lining tin cans with thin sheets of aluminum. His apparatus works by means of compressed air. A pile of sheets of aluminum is stacked on a stand at one end of the apparatus. The top sheet fits around a metal form the size of the can to be lined. The tin can then is slipped over the form, as shown in the picture above.

A small compressed-air tank operated by striking a plunger with the hand, supplies compressed air to the interior of the form. This forces the aluminum lining to adhere to the interior of the can. It makes the food look much more appetizing.

Torpedo Guided by Wireless for Aerial Defense

A TORPEDO directed from the ground by wireless, that is said to be capable of destruction in a radius of 100 miles from the firing base, is the remarkable invention designed by Captain Albany Roberts, of New Zealand. It is being investigated by the British Ministry as a successful defense against future air raids.

The torpedo can be sent in any direction in the air, it is said, and maneuvered as the operator controlling the wireless apparatus on ground desires. It has a safety device to prevent the torpedo from exploding below a certain altitude.

The Baby Now Can Motor in Perfect Comfort

The auto-carriage fits snugly in the car

THE baby now can go motoring with more comfort than grown-ups, for inventors have devised a combination baby-carriage-crib and high-chair all in one. It fits inside of any automobile, either in the front or back seat.

It may be fixed so that the baby can sit up in it or, if he is tired and sleepy, a catch can be released that turns the chair into a crib. At the end of the destination it becomes a carriage. The standards on which the carriage rests are adjustable to various depths.

Novel Alarm Scares Burglar with Loud Blast

THE burglar who opens this door is going to have the surprise of his life Attached to the end of a chain that fastens across the door on the inside is an explosive cartridge. This is hung on the door.

Any one entering, unaware of the presence of the alarm, pulls the end out of the cartridge. This explodes a charge of powder, making a sharp but harmless blast intended to frighten the prowler away and awaken the household.

Analyzes Fruit Juices Cooked in Metal Containers

IN MANY households kettles and other kitchen utensils of iron, copper, brass, or aluminum are used for boiling fruit juices, sour or salty broths or stews. In view of the fact that nearly all salts of metals are more or less poisonous, Mr Jarvinen, chemist of the municipal laboratory for hygienic research in Helsingfors, Finland, undertook a series of tests to ascertain the quantity of different metals dissolved in the liquids kept boiling in metal pots.

Two pounds of fruit juice, containing 40 per cent of sugar and 1.5 per cent of citric acid, was kept boiling in an iron pot for three hours. At the end of that period it was found that the liquid contained 1400 milligrams of iron in solution. If, in place of the sugar solution, a 5 per cent solution of kitchen salt (sodium chloride) was used, the liquid, after three hours of continuous boiling, contained only 104 milligrams of iron in solution

Under the same experimental conditions, fruit juice boiled in a copper kettle dissolved 65 milligrams of copper; that boiled in a brass kettle, 0.5 milligrams of copper; and that boiled in an aluminum kettle, 120 milligrams of aluminum.

Adjustable Lap-Desk an Aid to the Student

A DESK that rests in the lap and can be adjusted to any angle permits the user to read or write with comfort, or to study with correct posture. It can be used in bed by sick persons or those who like to read while lying down, by artists, stenographers, and draftsmen.

It consists of two boards joined by six legs with ball-and-socket-joint connections. The desk can be locked in any desired position and weighs very little, so that it can be carried easily from place to place.

How the desk rests on the knees

First Rural Air Mail

WHAT is said to be the first airplane rural mail route in this country was started recently in New Hampshire. Newspapers and letters were carried 43 miles to vacation colonies on the shore of Winnipesaukee Lake.

New Pen Makes Lettering Easy for Amateurs

A NEW pen with "ball bearing" point is designed for bold lettering. It works so easily, it is claimed, that the inexperienced person can do attractive lettering with the neatness of a professional

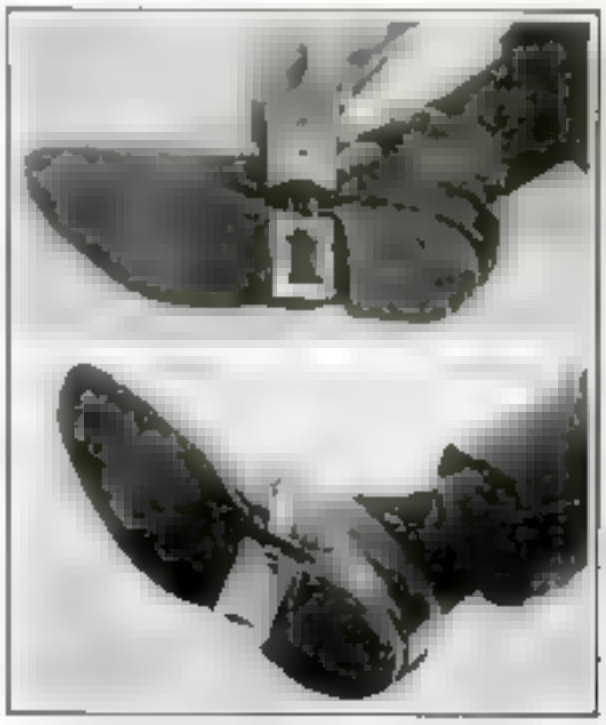
The point prevents spattering of ink while the pen is pushed backward or forward, keeping the letters neat and clear cut.

ABOUT 415,000 long tons of rubber were produced in the world last year and the United States used 77 per cent of it, compared with 46 per cent in 1905 when world production approximated 60,000 long tons.

New Ice Creepers Detached from Shoes Quickly

WHILE spikes for the shoes are often very useful in winter when the walking is slippery, in the house or store they are ruinous to floors and rugs. Yet for the man who must go indoors and out many times a day, repeated removing of ice creepers is a nuisance.

A new ice creeper has spikes that may be detached without removing the creeper



Above: How the ice creeper is detached. Below: The creeper in place

from the shoe. Pressing a spring releases the tongue of the spike plate from a groove in the part strapped to the foot. Replacing the spikes when going outdoors takes but a moment.

Crawl Stroke for Motorboats

THE Australian crawl principle that produces some of our fastest swimmers now has been applied to motorboats. A new propeller invented in Austria resembles a pair of double fins mounted on a horizontal shaft in the same position as a screw propeller. These do not rotate, however, but oscillate, suggestive of the kick-stroke of the crawl

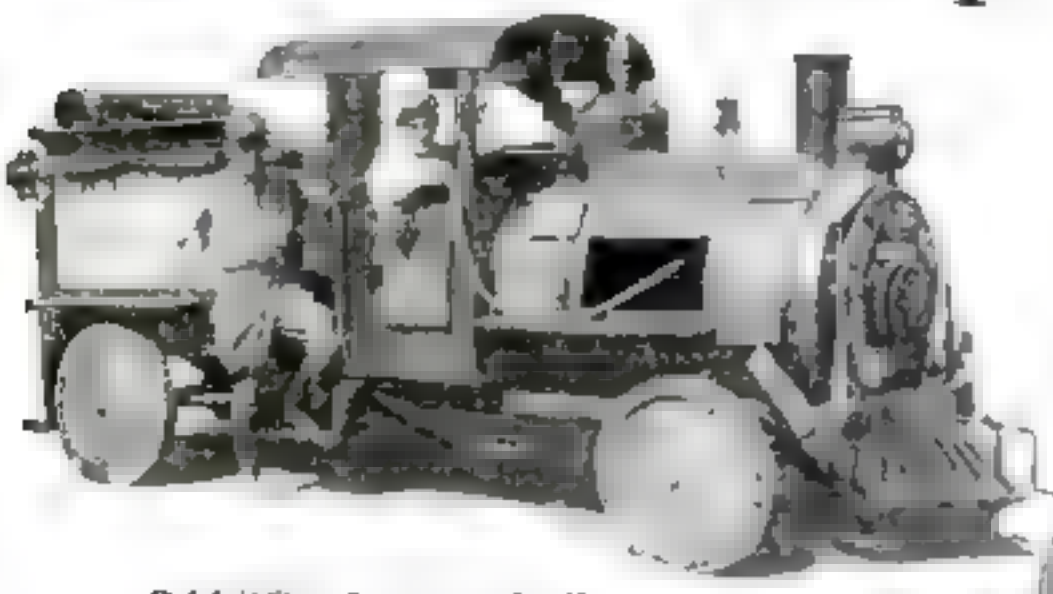
The new propellers are said to save fuel, conserve power, and increase speed. They may be used also, it is claimed, on airplanes and dirigibles.

Radio-Active Water Produced Artificially

THOUSANDS throng every year to health resorts famed for the radio-active water from their springs. Now a health spring for the home is said to have been achieved by the invention of a new water container lined with porous radium ore. It is said to impart to drinking water coming in contact with it radio-active properties needed by the body. The photograph shows James J. Jeffries, former world champion heavyweight boxer (center), with two young pugilists, sampling the treated water

"Jim" Jeffries (center) and two pugilists sampling the water

Novel Machines Built Out of Scraps



Odd "Gas Locomotive"

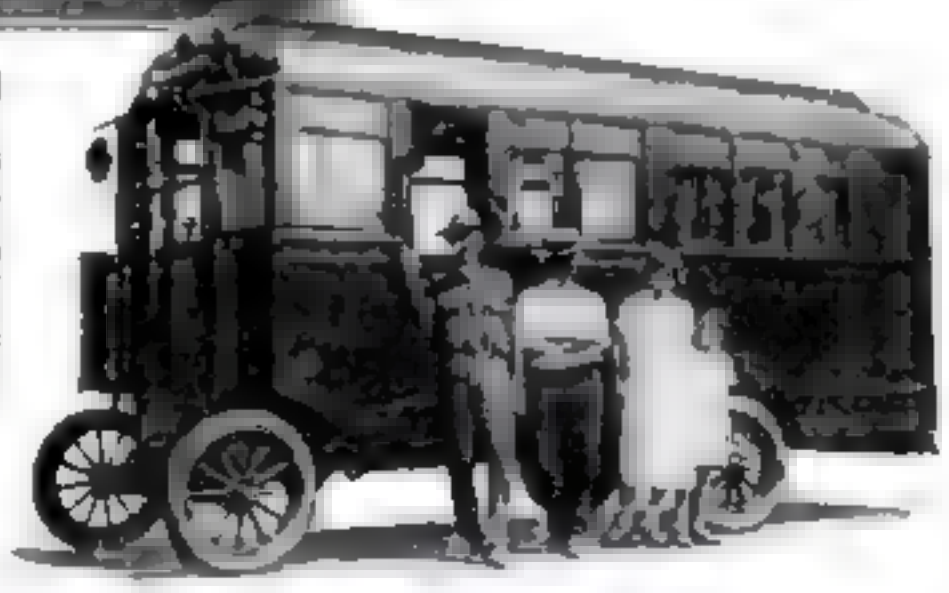
In this odd vehicle made from an old auto chassis and odds and ends from the junk pile, C. D. Conklin and W. J. Sellers, war veterans, recently toured from Los Angeles to Washington, D. C.

Old Inner Tube Useful

With the aid of this "rubber man," made from the inner tube of a discarded flivver tire, E. F. Wasco, a timber faller in a lumber camp near Bend, Oreg., has broken all cutting records for his district. The rubber man is attached at one end to a cross-cut saw, and at the other end to an iron stake driven in the ground near the butt of the tree

An Ingenious Windmill

A few boxes, a broken table, and an old bicycle wheel were used by George Foster of Brewster, Mass., to build the unique windmill above. Cape Cod winds are all the incentive needed for this faithful servant, which pumps water, saws wood, turns the washing machine, and does a score of other household tasks



A Bicycle Lawnmower

Half a discarded bicycle was put to good use when it was attached to the lawnmower, as shown, by Victor and Richard Dorn, of Red Bank, N. J.

Builds Ditching-Machine

Almost every kind of junk was used by H. O. Dahlin, of Woodford, Wis., in constructing this ditching-machine for his farm. An old auto furnished the differential and transmission

Motor Home from Scraps

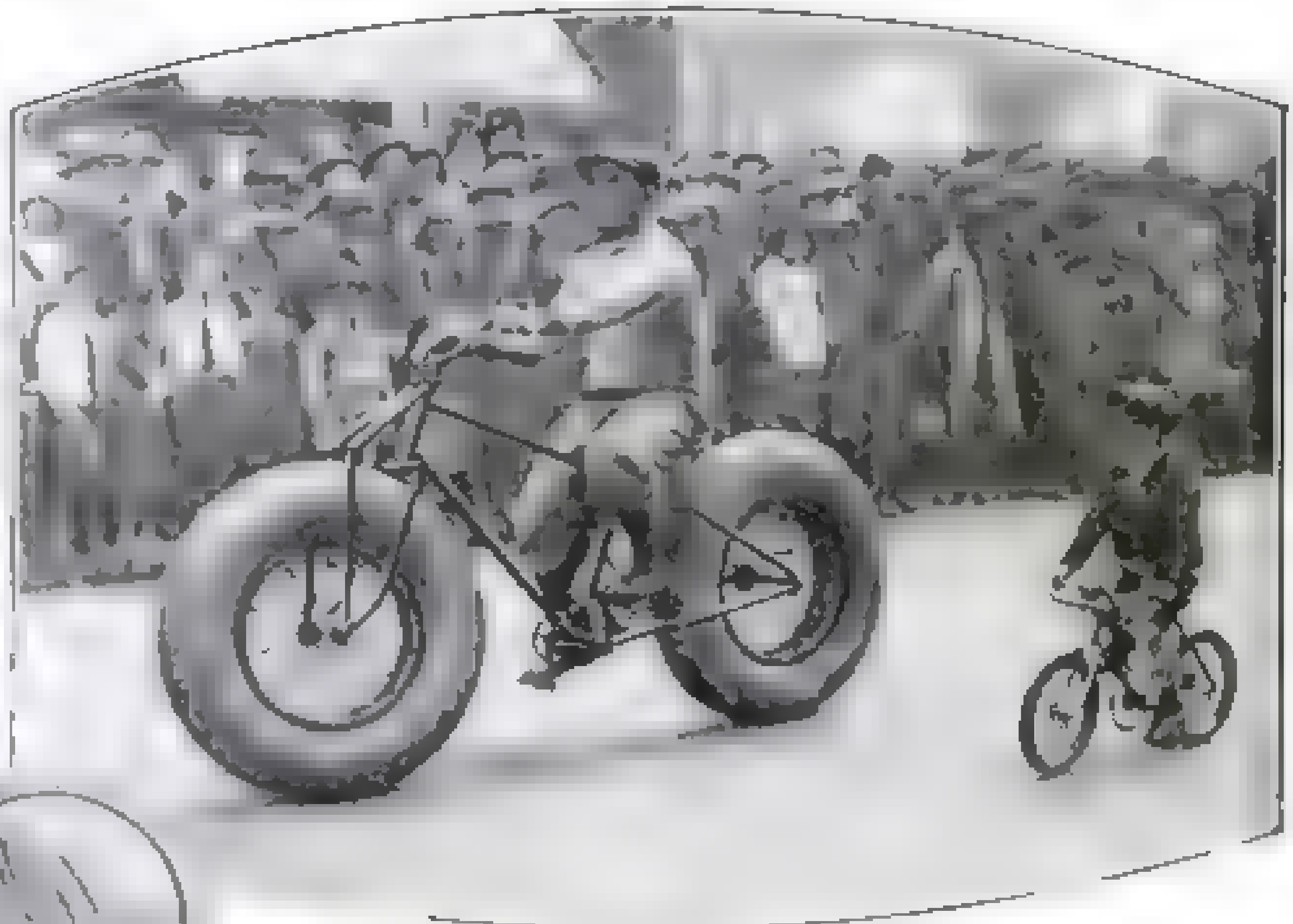
From cast-off parts found in alleys and junk piles, A. L. Campbell, a salvage engineer of Chicago, and his 16-year-old son, put this house on wheels together in their back yard. It has running water, four berths, a dining-table, ice-box, bathroom equipment, and electric lights

Some Queer Ways *to* Get About

How Would You Like To Ride on One of These Odd Vehicles?

Balloon Tires Add to Bicycle Comfort

A bicycle equipped with balloon tires appeared not long ago in a parade on Chicago streets, accompanied by a midget bike ridden by a small boy. The big tires add much comfort to riding



Why a Motor?

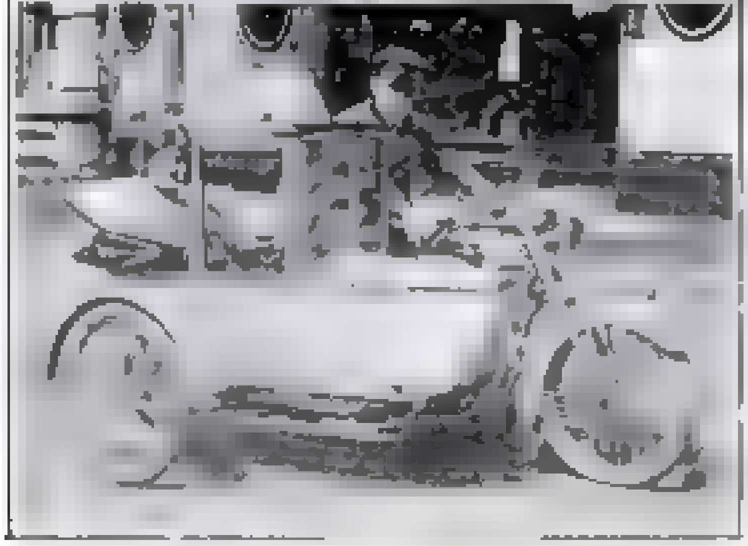
Instead of a motor, George C. Sawyer, New York engineer, invented this odd motorless motorcycle propelled by the driver's weight on an arrangement of geared treadways. He says it can go 30 miles an hour

A Monorail "L"

At the right is a remarkable monorailway just completed between Vohwinkel and Elberfeld, Germany. The rails from which the cars hang are suspended from steel arches

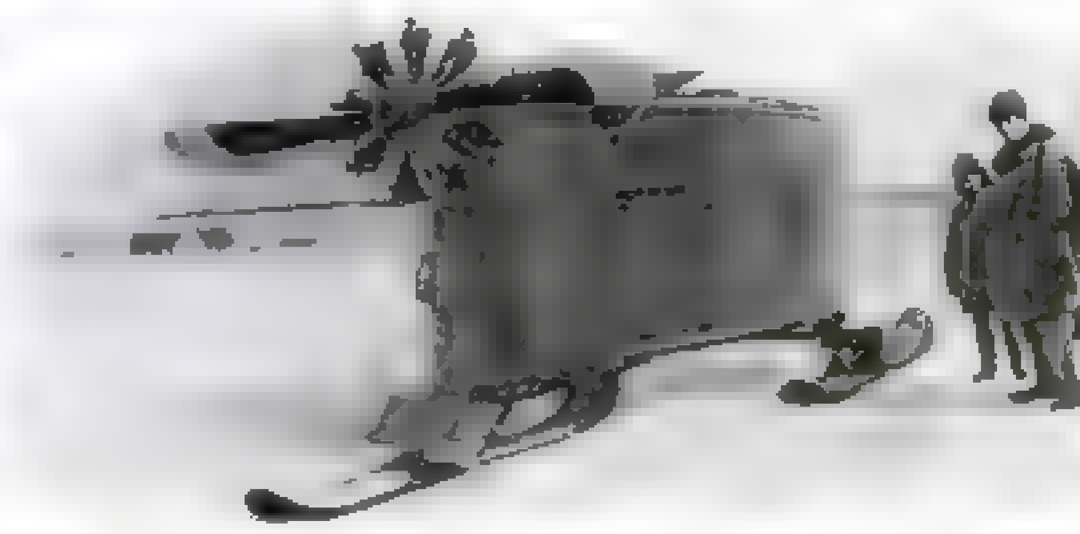
A Real Joy Ride

The latest innovation in kiddies' tricycles is this miniature velocipede with little sidecar attached. Son takes sister riding now



Three-Wheeled Taxi Proves Popular

Midget motorcycle sidecar taxis such as this have become popular recently in Berlin, Germany, because of their comparatively low cost of operation



Air-Driven Ice Bus Runs on Skis

Mounted on three skis and driven by an airplane propeller, this snug bus carries passengers between Helsingfors and Sveaborg, Finland

New Time-Saving Tools

Portable Electric Saw Is a Fast Lumber-Cutter

FOR ripping or cross-cut-saw work, a few years ago anything was good enough. But an old hand saw meant slow work and worn-out workers. Now a new portable electric saw tears through thousands of feet of lumber a day, it is claimed, cutting production costs.

It may be used, also, in cutting bone, wallboard, plaster-board, fiber, linoleum, hard rubber, light-gage soft metal, and bakolite. It is provided with a dust shield which can be removed without the use of any tools. It operates from any light socket and is used with either six-inch or seven-inch blades.

Fine Wires Prevent Breaking of Windshield Glass

A NEW plate glass for automobile windshields is reinforced with fine wires running parallel to each other at intervals of two inches. Recent tests showed that such material would minimize the danger of injury from flying glass in case of accident. It stood both shock and impact without shattering, although of course it cracked when a metal block weighing 3¾ pounds was thrown against it at close range.

Eight-in-One Wrench Useful for Adjusting Spark Plugs

HERE'S a wrench that is said to be one of the handiest of tools for the automobilist's outfit, besides being useful for other purposes.

This recently devised socket wrench takes up little space in the automobile tool-kit and fits almost every nut on the car, thereby saving much time for the amateur mechanic. It is eight different wrenches in one.

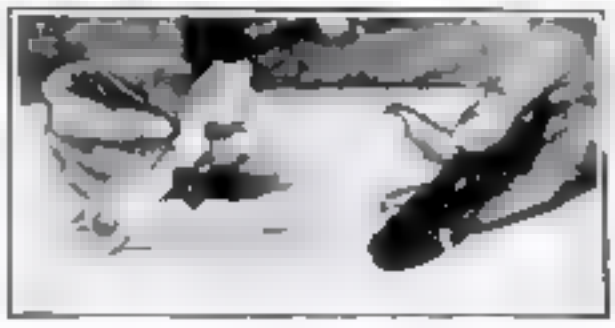
It is especially useful for fitting on spark plugs, it is claimed by those who have used it for this purpose. The illustration shows how the wrench fits on the spark plug.

Power-Driven Tool Cuts Out Mortar between Bricks

IN POINTING up bricks, a new and ingenious machine is used for cutting away the old mortar between the brick construction joints. A one-quarter-horsepower motor operating at 3500 revolutions a minute drives the cutting wheel. The shaft, which is connected directly with the motor, is provided with a metal-wound casing and also a hand piece and safety guard for protecting the operator's hand from flying chips.

Special rubber bond wheels, of various widths, are used in order to handle different widths of mortar encountered in the various types of brick construction.

Cutting out mortar with power tool. A safety guard protects operator's hands



Combination Vest-Pocket Tool Is Handy for Radio

TWO slotted strips of metal hinged together have a surprising number of uses. The device is a combination tool for radio fans, electricians, mechanics, automobilists, or artists. It may be used as a ruler, wire cutter, wire stripper and cleaner, screwdriver, wrench, counter sinker, and is especially handy for working radio panels.

The tool fits into a small leather case that slips easily into the pocket.

Vegetable Ivory Resembles Elephant-Tusk Product

VEGETABLE ivory is one of nature's wonderful products that may be used, it has been discovered, for practically everything for which tusk ivory is used. It is derived from the nut or seed of a palm, that grows in Central and South America. The seeds grow in the fruit or head of the palm, which is about the size of a man's head and weighs from 25 to 30 pounds. Usually a head contains from 40 to 50 nuts.

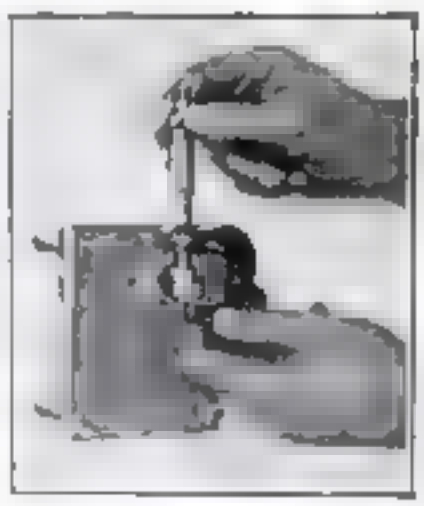
The seeds are solid, white, and hard and, when polished, scarcely can be distinguished from animal ivory. The unique product is used in the manufacture of door knobs, umbrella handles, and small ornaments, but its chief use is in making buttons. These ivory seeds form the chief industry of the interior of Colombia.

The United States imports more of this ivory than any other country.

New Taper-Gage Measures Odd-Sized Holes

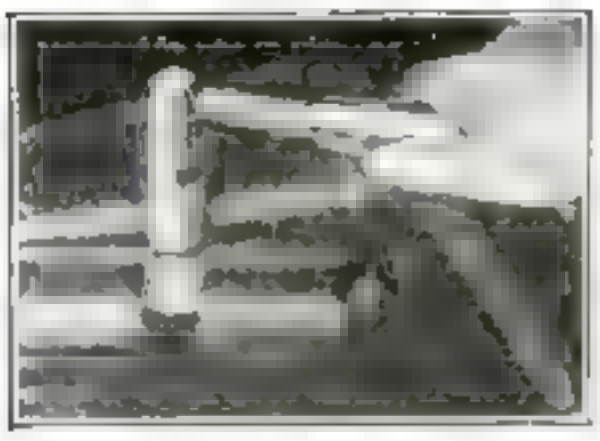
TO MEASURE accurately small holes that vary from standard plug-gage sizes, a new set of taper parallel gages has been designed. These are especially handy in a small shop where a complete set of plug gages is not kept on hand. They are useful in checking out-of-the-way holes that sometimes are hard to measure on jig and fixture work.

The gages are used in pairs to measure holes from one-quarter to one inch by thousandths of an inch. Two gages fit into the hole snugly and their combined thickness equaling the diameter of the hole, is measured with a micrometer



Especially adapted for small shop use is this new taper gage that measures small holes between standard sizes. It also tells whether the hole is out of round. A set of the gages is shown in box at left

Simplify *Old* Problems



Universal Auto Wrench Grips Hard-to-Get-At Nuts

THE head of this wrench can be set at any angle and as there is a reversing ratchet built in, it is said to be especially useful wherever nuts and bolts are hard to get at.

Automobile design often requires that some of the nuts be placed where ordinary wrenches cannot be used. This wrench will do the job easily, it is claimed, without marring the edges of the nut. There are also extension pieces that can be attached in a variety of ways to meet practically every need.

Elevator Telephones Assist in Avoiding Disputes

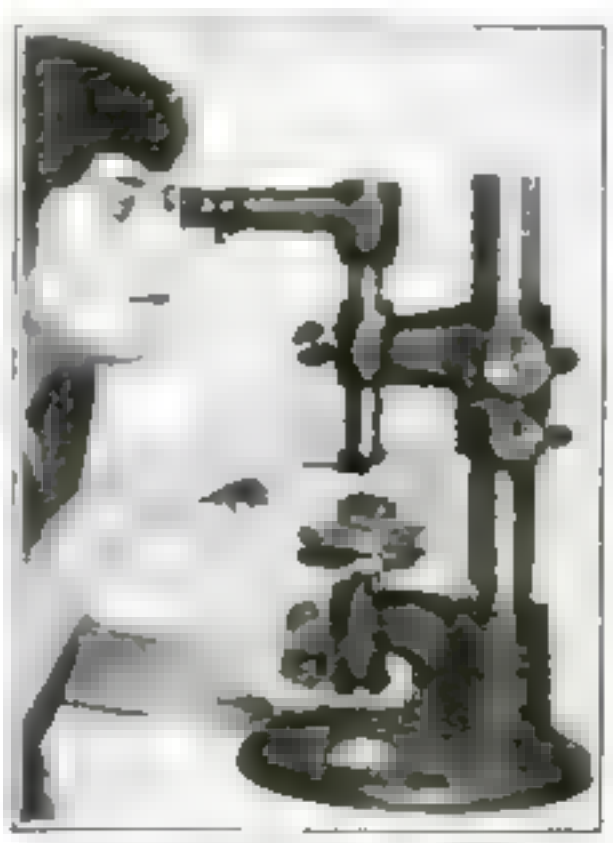
NOTICING that apartment-house tenants seemed fond of airing their troubles to elevator operators, the owner of a de luxe apartment house in New York City installed an unseen telephone in the elevator. As a tenant rides up or down in the elevator, she unknowingly talks to a young man at the other end of the line, who is sitting out of sight in the entrance hall below. If she tells him about the burned-out fuse, or the leak in the sink, the matter is attended to at once, and the apartment-house gears shift smoothly. It is a great success, according to reports, in keeping the tenants content with their landlord

Measures Twenty-Thousandths of an Inch Accurately

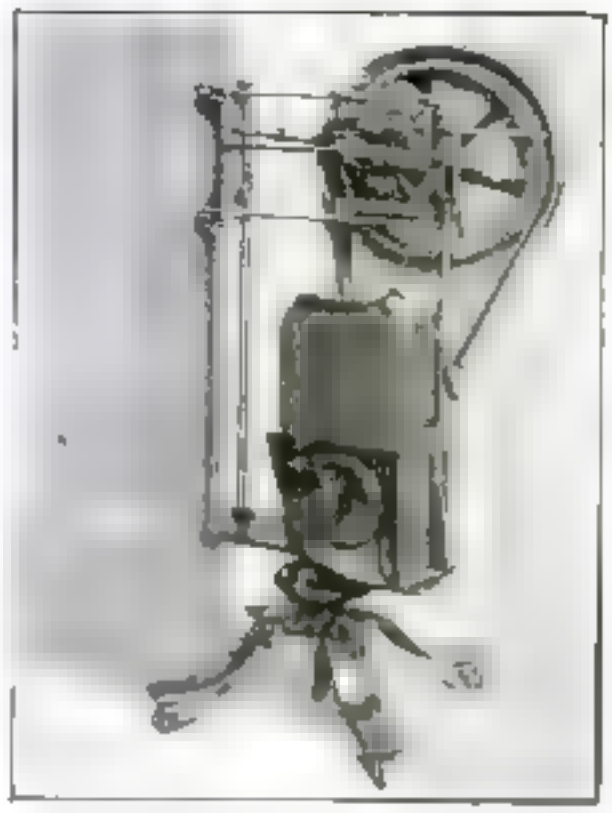
MOST methods of measuring extremely small distances are slightly inaccurate. In micrometer screws, for instance, oil films between the lubricated parts sometimes affect the measurement. It is very difficult, too, to get markings on dials that are exactly correct.

A recently invented instrument called an "optometer" is claimed to measure 1/20,000 inch with exactitude. The scale itself never is moved or touched, but merely is observed through a microscope. To the eye the 1/20,000 inch appears to be one-sixteenth of an inch.

The readings are not affected by variations in sense of touch or differences in human skill. In measuring infinitely small parts of an inch, the results of this instrument may be relied upon absolutely, the inventor claims.



In this remarkable measuring instrument the scale is read through a microscope



New Electric Mortiser Cuts with Automatic Precision

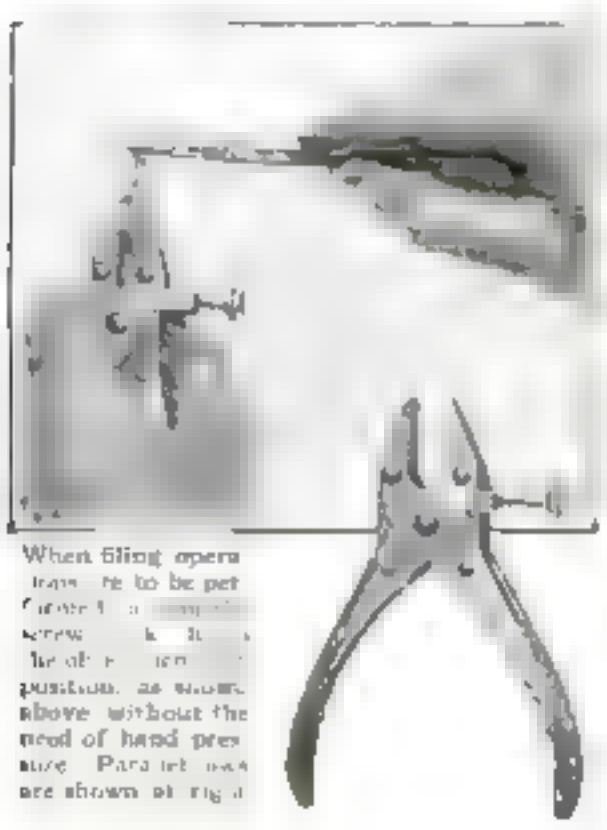
TO REPLACE the slow and costly hammer-and-chisel method of cutting mortises, an electric motor-driven machine recently has been put on the market.

With this it is said a perfect door-lock mortise can be cut in two or three minutes. It can be used on thin pieces such as screen doors, as well as on wide and heavy boards.

A bit of the proper size is inserted in the mortiser and the machine set for the center position and length of the mortise. A depth stop is set so that the machine is halted automatically when the machine has cut to the proper depth required by that particular piece of work

A NEW substance in paste form for adding to concrete mixtures, it is claimed, hardens and colors them at the same time. It also waterproofs the concrete to a certain extent. It comes in red, brown, green, and several other shades. Thus, by the use of this new substance, it is possible to color and harden concrete floors in one operation.

Hand Vise and Pliers Skilfully Combined



When filing opera[illegible] to be per[illegible] screw [illegible] the other [illegible] position, as shown above without the need of hand pressure. Parallel jaws are shown at right

A NOVEL tool that combines pliers and a hand vise is the recent invention of W. A. Bernard of New Haven, Conn., who has made a life study of pliers. The tool is fitted with a thumb screw, which when backed out as far as it will go provides a pair of parallel jaws for ordinary use around the workbench or the automobile

Often, the user of pliers finds it necessary to hold them in clamped position for several minutes at a time; as, for instance, in filing a key blank to the outlines of another key. A thumb-screw lock on this tool makes it possible to retain one or more objects firmly in position after the hand pressure is released. Thus it is especially useful where several operations are to be done without the necessity for releasing the work.

Filing operations on round stock are said to be greatly facilitated. The tool comes in handy also, it is said, for soldering small parts of a machine, engine, or radio set.

Invents Puller to Remove Battery Connectors

CONNECTORS on the terminal posts of storage batteries often become corroded and difficult to remove with screwdrivers or other tools commonly used for the purpose.

Clarence E. Moss, of Ponca City, Okla., has invented a tool that makes it possible to pull off the terminal connectors easily

As the photograph at the right shows, the device consists of a pressure bar in the middle bearing directly against the battery terminal, and jaws with a claw hook that fits under the lead terminal of the storage battery.

New Household Helps for

Work Is Lightened by the Use of the Best Tools and

Rug-Cleaner Has Six Rotors

A new rug-cleaner is said to work wonders in beating out dust by means of six small rotors. It is claimed that dust rolls out after the device runs over the rug several times

Pincushion Straps on the Wrist

While shown on the wrist, this handy little pincushion is adjustable as well to a dressmaker's or tailor's belt or any handy part of the clothing, and saves many motions in making a garment

Easily Opened Bottle

In a new type of bottle recently developed, a coin, knife, or key, or any flat piece of metal will remove the cap with ease. The rim has a ledge below the cap so that the opener acts as a lever

Nail Polish in a Stick

Pictured below is nail polish in stick form, that unwinds as it is used, somewhat as paper lead-pencils are sharpened. The buffer beside it is a new sanitary one that is readily adjustable so that a clean chamois for each manicure is possible

One More Biscuit-Cutter

Biscuits in a jiffy. Every time the little device illustrated below revolves, it cuts out a biscuit or a cookie. It is made of aluminum and in consequence is very easy to handle and will not become tiring to the housewife

Baby's Bath and Dresser

This new rubber bathtub for the baby saves the mother from bending over One end is a dressing-table The whole can be folded into a compact bundle that is smaller than a suitcase

Locking-Dog Foils Burglar

This strange device is a locking-dog, and its purpose is to foil burglars. It is pushed into the keyhole after the door is locked and the key removed. A padlock makes it secur

Stones Two Cherries at Once

Cherries are fed into the trough of the novel cherry-stoner pictured at the left, and fall into two holes. When the handle is raised, two prongs close into holes, forcing out the cherry stones

A Square Cooking-Spoon

The square edges of this new cooking-spoon scrape the corners of a pan or a dish, and prevent the burning or sticking of food. Perforations in the bowl of the spoon allow the liquid to escape when solids are to be tested. The spoon may be used also as an egg separator or for draining off liquid

the Woman in the Home

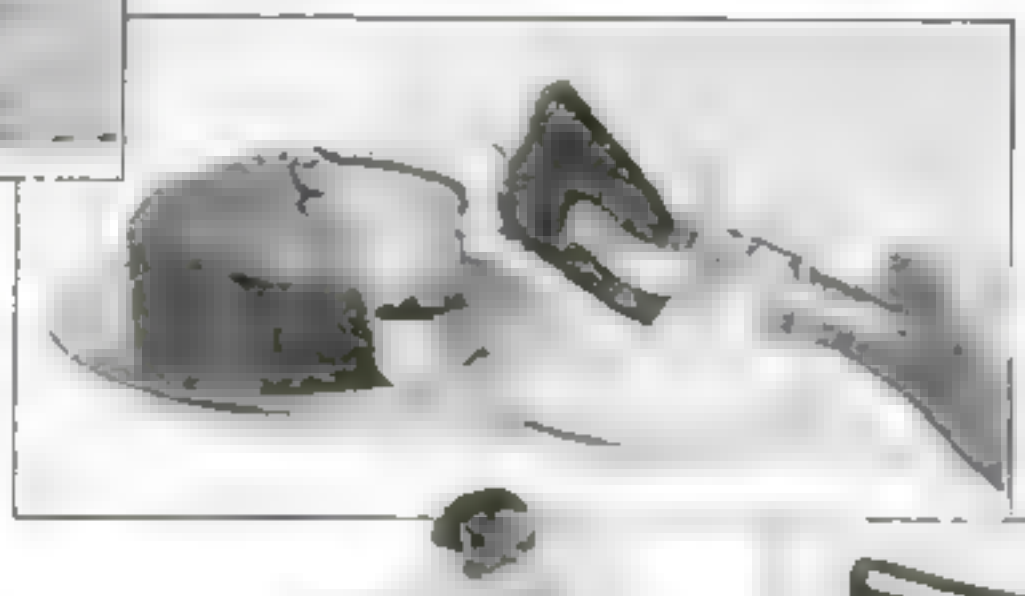
There Is a Constant Supply for Every Need

Simple Steel-Wool Holder

Steel wool is extremely useful in the house, but it often injures the fingers. The illustration at left shows a steel-wool holder with a new wad of wool being tucked into the groove

Cake-Cutter Is a Lifter, Too

Below is pictured a fine, sharp knife, attached to which is a pair of broad tongs that lift a slice of cake from dish



No More Towels on the Floor

Sonny pulls at the towel on its gravity rack. But the pull merely tightens the rack's hold and locks it automatically until mother wishes the towel removed from the rack

Rattling Windows Silenced

Placed in between the window strip and frame, the little device shown below quiets a rattling window in a jiffy. It can be attached permanently to the window frame or merely pushed in when it is needed

Metal Spoon Is Good Mixer

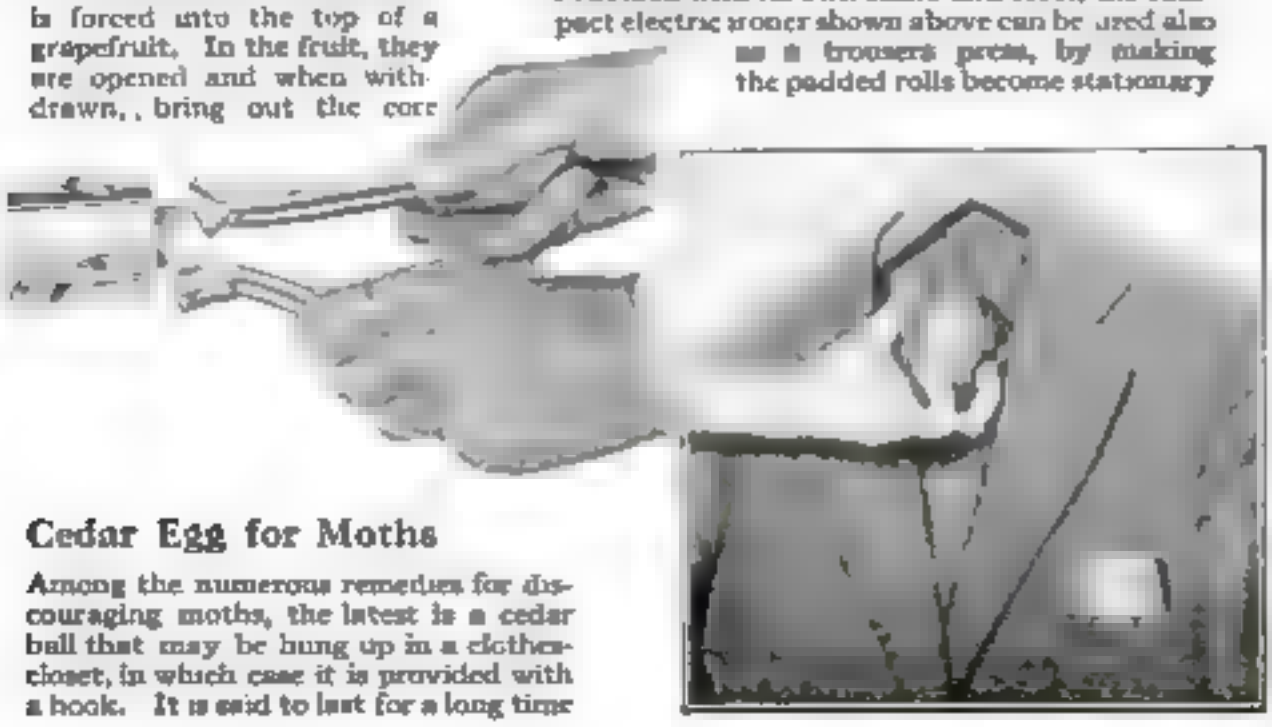
A wide metal spoon with slots is designed especially for cake-mixing, but it also beats eggs and mashes potatoes. The fingers find an easy grip on the big grooved handle

Grapefruit-Core Remover

The handles of the cutter below are closed and the device is forced into the top of a grapefruit. In the fruit, they are opened and when withdrawn, bring out the core

Ironer Built for Small Homes

Provided with its own stand and stool, the compact electric ironer shown above can be used also as a trousers press, by making the padded rolls become stationary



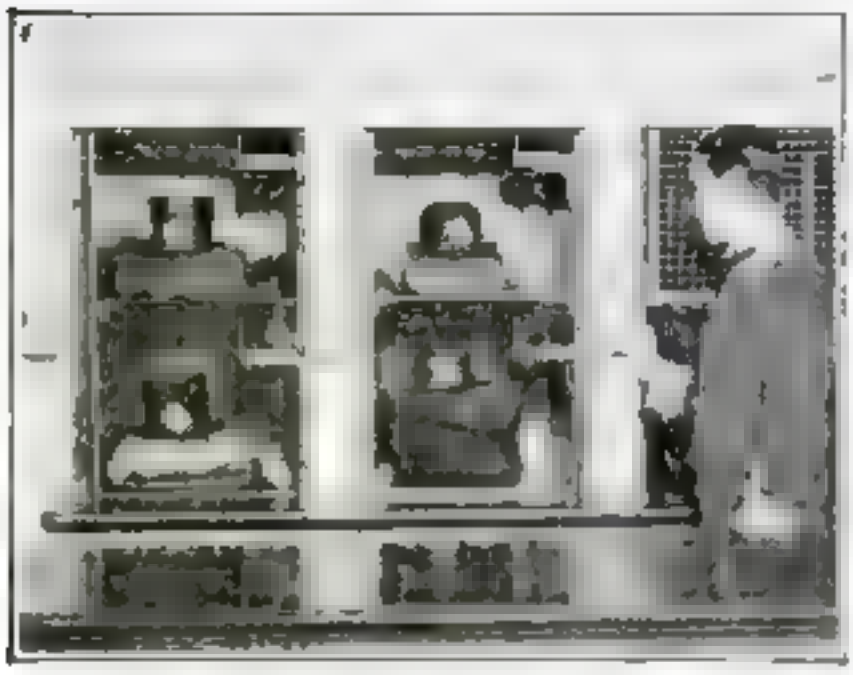
Mixing-Bowl or Pulverizer

In jelly season this novel food pulverizer can be used as a fruit press. As a vegetable press, sieve, colander, ricer, or to make bread-crumbs, it has many every-day uses. The frame that holds the bowl is held firmly to the kitchen table by means of thumb-screws

Cedar Egg for Moths

Among the numerous remedies for discouraging moths, the latest is a cedar ball that may be hung up in a clothes-closet, in which case it is provided with a hook. It is said to last for a long time

Electric Elevator Delivers Hats and Coats



The footman presses a button to set the elevator in motion. It travels up and down at a speed of 70 miles an hour

"HAT and coat, sir? Your check, sir?" and the footman presses a button and opens the door of an electric elevator. The hat and coat come into view and are delivered to the waiting owner.

This elevator, which does away with the check room on the main floor, was installed recently in the Savoy Hotel in London. It is said to attain a speed of 70 miles an hour and to handle 1000 loads an hour. Notice that there is a place in each compartment for the Englishman's indispensable walking stick.

"Beef Extract" Manufactured from Fish Refuse

A WAY has been found to make an extract resembling that of beef out of fish refuse. At Boulogne-sur-Mer, France, tons of refuse left on shore daily by fishing fleets used to be given away to fertilizer manufacturers. In the future these manufacturers will have to compete with a canning company that wants it for the new food product. Rights to make the extract have been obtained for the United States.

Autograph-Telegrams Popular

BELINOGRAPH, the system of sending photographs of autographed telegrams by wire, is becoming popular in Europe. The cost of sending an autographed telegram has been reduced in France to 25 cents.

Many advantages are pointed out for this new type of telegram. Messages need not be translated for transmission. One hundred words can be written easily on a form and go as a single photograph. The sender can be sure that his message will be delivered exactly as he wrote it and the receiver can identify the sender by his own signature.

Moreover, the transmission is declared to be very rapid.

High Seat for the Baby Will Fit Any Chair

A NEW high-chair attachment provides a seat for the small child any time, where ever an ordinary chair is available. It has rubber-covered steel hooks that fit over the back of a chair and are adjustable to various makes of chairs. Made of canvas, the attachment folds into a small package easy to carry when touring or traveling.

New Portable Arc-Light Uses Minimum of Current

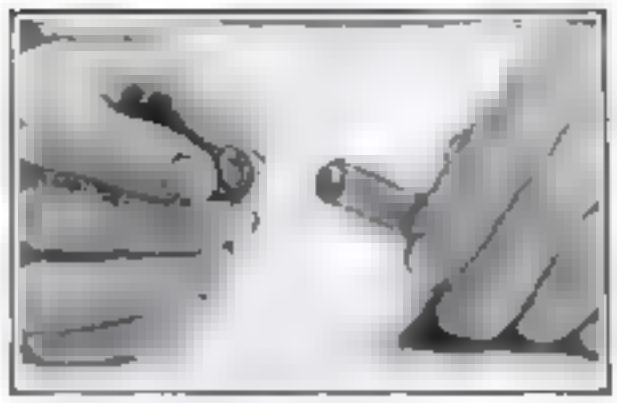
THE remarkable feature of this new portable arc-light, designed for use in photography or for producing stage lighting effects, is the fact that it uses only six watts of current.

Various types of portable arc-lights have, of course, been in use for many years, but this is the first model that uses only one-seventh of the power required to operate ordinary electric-light bulbs such as are used in houses.

A New Gas Mask

A GAS mask that produces its own oxygen has been invented by H. C. Carter of Victoria, Australia. Renewing gas in masks long has been a difficult problem in masks used by miners and divers.

This picture was made with illumination from a portable light like the one shown here



Billiard-Cue Tips Fastened by Ingenious Joint

LEATHER tips on pool or billiard cues have an annoying tendency to drop off at an exciting part of the game. H. L. Wheeler, of Springfield, Vt., recently invented a new way of applying the tips to avoid this. The point of the cue is turned with a cylindrical projection that fits into a recess in the tip. The tip then is applied with glue in the usual way, but the method is said to provide a much firmer joint than the conventional method.

If the tip should break in a game, another can be put on and will stay fixed for several games without glue, the inventor claims. The tips are made in many different styles.

Uncle Sam Trying to Make Dollars Last Longer

HOW to make one-dollar bills last longer is the subject of intensive experiments now being conducted jointly by the U. S. Bureau of Efficiency and the Bureau of Standards.

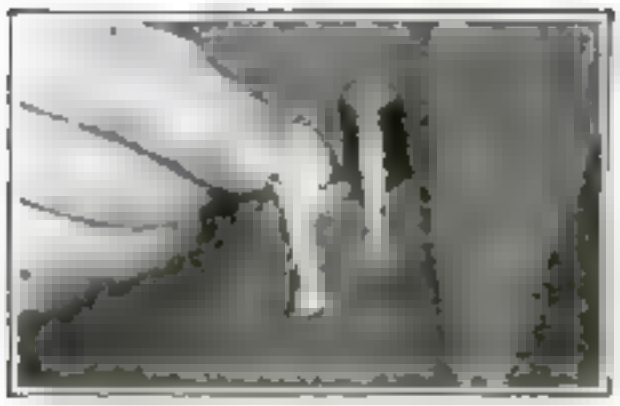
Twenty carloads of these bills are manufactured by Uncle Sam each year. Due to the quality of the material now used, they wear out sooner than the experts think they should, and must be replaced. At present the paper money is made from rags—about 75 per cent linen and 25 per cent cotton.

Experiments are being conducted to see if the government cannot employ stronger bases, such as wood pulp, Manila hemp, African grass called esparta, and Kansas wheat straw. The government has its own paper-making machines, which can produce paper from various materials.

Hammer-Head and Handle Forged in One Piece

A HEAD that cannot fly off and a handle that cannot break are the advantages claimed for the new type of hammer pictured below. The handle and head are forged in one piece of steel. The end of the metal shank is covered with wood to provide a good grip.

Pulling a nail head through the wood with the new hammer, welded in one piece



Vest-Pocket Savings Bank Holds Four Dollars in Dimes

A VEST-POCKET bank to catch stray dimes before they slip away, clips on the pocket like a fountain pen. It is only four inches long, and because it is wedge-shaped so that the dimes stack up at an angle, its thickness is not more than half an inch

The little bank will hold four dollars. A woman can slip it into her handbag The bank is locked with a snap-spring which is opened with a key

New Safety Fire Hydrant Is Shock-Proof

SHOCK-PROOF fire hydrants were installed recently in Los Angeles, Calif If a careless motorist knocks one of the plugs out, a safety valve in its base automatically shuts off the flow of water.

Another advantage is a valve arrangement that permits a fire engine to be coupled to the hydrant without shutting off the water. In the photograph Battalion Chief Blake of the Los Angeles fire department is seen testing one of the hydrants.

Battalion Chief Blake of the Los Angeles Fire Department (at right) demonstrating the automobile-proof hydrant

DISCOVERY of a solder suitable for welding aluminum recently was reported from Germany It is said to be composed of seven different metals.

Oar-Propelled Kiddie Cart Gives Rowing Exercise

WHILE physical instructors generally agree that rowing exercises more muscles of the body than almost any other sport, it is one form of exercise usually denied to children. Boats are too heavy for their strength.

A new play cart gives the rowing exercise on dry land. Except that the child sits facing the "bow" while pulling on the oars, the movements are the same as in rowing a boat The little cart is driven forward from a sprocket drive on the rear axle, the chain being pulled by the "oars," which must be raised before sliding back to first position.

Steering is done by the feet. The cart is furnished with a slide seat, if desired

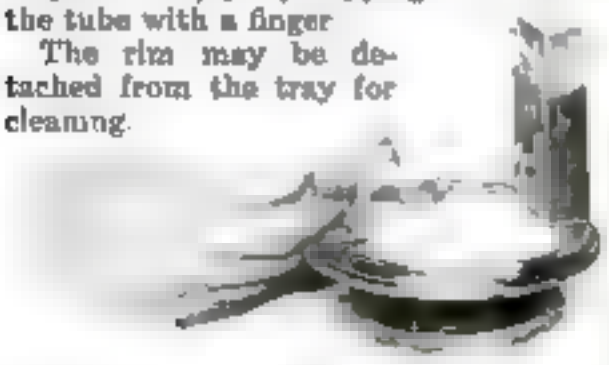
Pulling the little oars propels the cart forward. Steering is done with the feet

WHEN your fountain pen runs dry and you have no way of filling it, usually you can obtain a supply of writing fluid simply by filling the tube about half full with water. As a rule, there are enough ink crystals in the tube to make a fairly good writing fluid.

This Novel Ashtray Holds Cigarette Extinguisher

A COMBINATION cigarette extinguisher and ashtray is made of non-breakable, washable porcelain enamel. It cannot tip over easily. When the smoker finishes a cigarette, he simply drops it, lighted end first, into a tilting tubular receptacle, where it is quickly extinguished. The receptacle then is emptied simply by flipping one end of the tube with a finger

The rim may be detached from the tray for cleaning.



The smoked cigarette is extinguished simply by dropping it in the tilting tube at left

Safety Key for Oil Tanks

TO PREVENT explosions caused by static electricity generated in filling a motor-tank truck with oil, a device has just been perfected in the form of a key that must be inserted in the cap and left there, in order to open the tank. This key is grounded so as to lead off any electricity generated.

The designer conceives new designs by looking at odds and ends of silk and metal through a tube containing kaleidoscopic mirrors

New Compound Kills Weeds in the Garden Path

UNSIGHTLY weeds along the garden path are doomed, according to information from Germany. Certain compounds have just been patented that may be added to the gravel before laying the paths in order to prevent any weeds from growing, or they may be powdered or sprayed on the weeds to kill them. The most potent of these compounds are the sodium and calcium paratoluene sulphonamides.

Vast Supply of Potash

A THOUSAND years' supply of potash for the American farmer, making us independent of supplies from Chile and other foreign countries, is possible as a result of a discovery of a new process for making potassium sulphate from greensand. Large quantities of this peculiar type of sandstone are found in Delaware, New Jersey, and Maryland near the surface so that it can be worked with steam-shovels.

Original Designs Created by Kaleidoscopic Tube

THOSE who figure out our designs for dress goods, wall-paper, and rugs are required to tax their imaginations. Sometimes they run out of ideas. A novel device called a "designoscope" has been invented recently to help them. It is designed to produce varied patterns and decorative motifs by means of small pieces of tinfoil, scraps of silk, colored paper, glass, jewels, in fact, almost any small objects.

The operator looks through a small hole at the top of a triangular tube that contains kaleidoscopic mirrors. The scraps of material are placed upon a white revolving disk directly below the tube. As these whirl around, the operator sees an ever-changing combination of colors and designs. The apparatus makes an entertaining toy, as well as serving its utilitarian purpose, for its possibilities are practically unlimited

Spectacular Feats

Some Thrilling Parachute Jumps—

Photos Developed in Flight

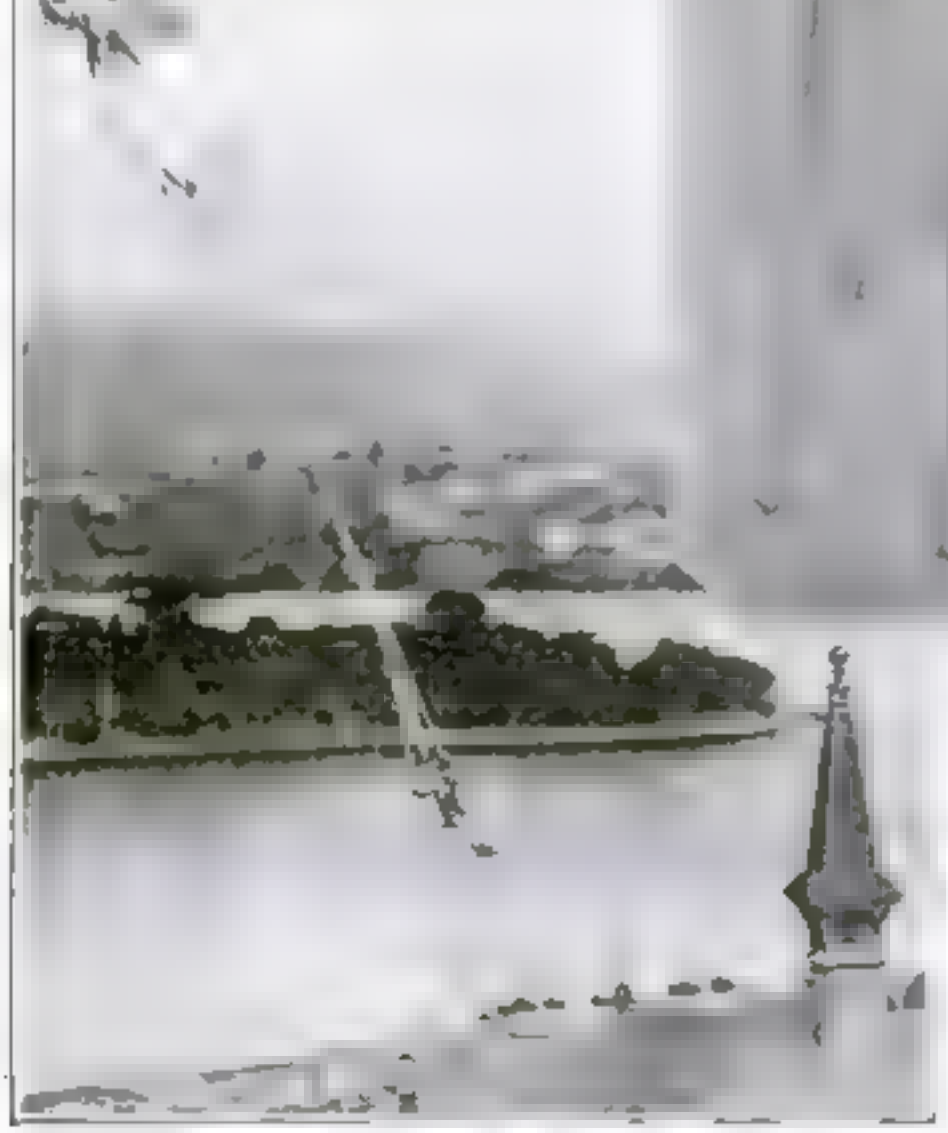
[illegible]

Jump from Balloon

[illegible]

To Cross Atlantic?

[illegible]



An Instant Later He Hit the Roof

When Al Reeves [illegible] plane above San [illegible] he fell [illegible] and he was badly injured. This unusual photograph shows Reeves an instant before he landed on the [illegible]

Mark Air Progress

The Latest in Motorless Gliding

Safe on Earth—The Two Jumpers

Here are the two famous parachute jumpers, Lyman Ford and Alga F. Starr, just after [illegible] recent thrilling jump from the ill-fated *Shenandoah*, at Lakehurst, N. J. Ford's parachute is at his feet, while Starr is showing how he carries the umbrella on his back

A Cameraman's Perilous Perch

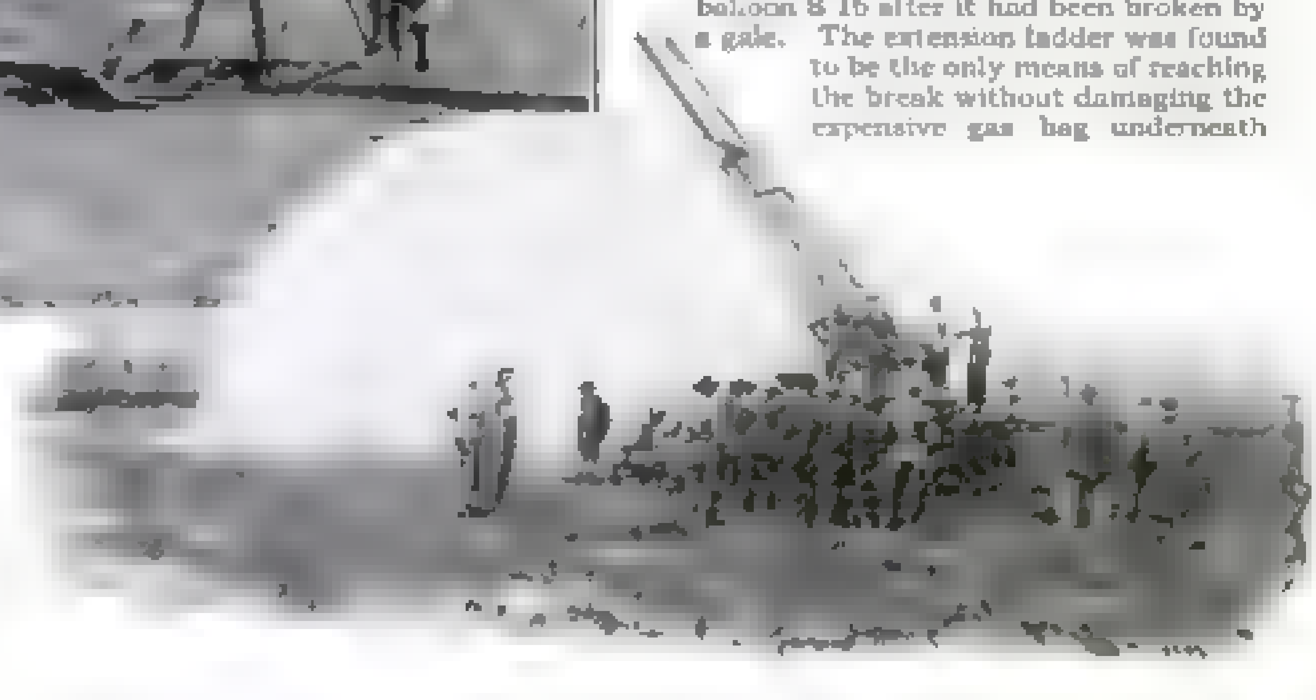
Here are two of the last pictures taken of the *Shenandoah* before her tragic crash in Ohi[illegible] Ab[illegible] J[illegible] D[illegible] shooting pict[illegible] of F[illegible] and Starr [illegible] ng their parachute j[illegible]mp. A[illegible] A parachute leaving the ill-fated [illegible]

A Fire Ladder to the Rescue

The photograph below shows how a fire-ladder apparatus was used in an attempt to repair the netting cord of the army balloon S 16 after it had been broken by a gale. The extension ladder was found to be the only means of reaching the break without damaging the expensive gas bag underneath

Motorcycle Lifts Glider

In latest experiments with motorless gliders, German aviation experts have developed this new method of hopping off. A motorcycle hitched to the glider pulls it along the ground until it has attained enough speed to rise. When the machine is aloft, a touch of a lever releases the tow rope and the glider soars on its own



Machine Turns Words into Code

The inventor and the machine he worked eight years to make perfect

Typewriter transmits telegrams in Morse or Continental

AFTER working eight years on his invention, Edwin H. Pierson, of Denver, Colo., has perfected a machine with typewriter keyboard that may be called "almost human," for it translates words into telegraph code, either Morse or Continental, so that any one who can use a typewriter can send telegrams, though entirely ignorant of telegraphic codes.

The speed with which a message is sent can be regulated to any desired rate. Likewise, if the operator should write unevenly or irregularly on the keyboard, the mechanism of the instrument adjusts it and sends the message perfectly spaced, with exact dots and dashes.

Similar in size and appearance to an ordinary typewriter, it is said to be easier to operate. There is no end line to watch, nor line spacing.

When not in use the sled runners can be folded up

Pram Is Converted into a Sled by Adjustable Runners

FOR a baby carriage or go-cart, a runner attachment changes it into a sled. The runners are lowered by a lever at the back of the carriage. When not in use, they are folded easily and raised above the lower portion of the wheels, out of the way.

They may be clamped easily to the axle of any go-cart. It requires but a few moments to prepare a sled for the baby.

He Protects Case of Precious Plumes with Poison Gas

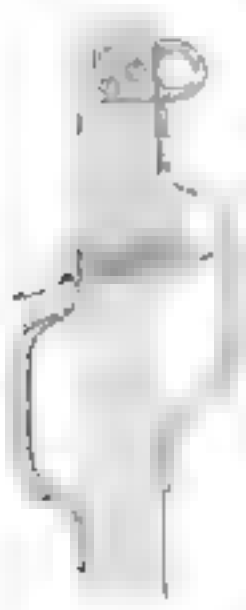
THE dean of the Maryland Academy of Science, Dr. Francis C. Nicholas, has originated an idea for guarding a rare collection of plumes of the bird of paradise and other fowls. The collection is in a glass case, and beside the beautiful gold and white plumes is a small vial labeled with a death's head. On the case the following notice is pasted:

"This case of plumes is protected by war gas. To open the case is to court death. The plumes have been poisoned and to handle them will result in serious injury."

METAL foil rolled to an amazing thinness is claimed to be the product of a new process invented by Karl Meuller, of Berlin. It retains its elasticity and becomes transparent. The discovery is hailed as of great use in the telephone, radio, and musical-instrument industries.

Double Door Latch and Grip Saves Irritating Delay

TRYING to open a door that happens to have its thumb latch on the other side means moments of exasperation. An ingenious latch that works both ways and gives a grip on both sides of the door eliminates these.



Double door handles

It can be used on any thickness of door, from 1⅛ inches to 2¼ inches. Two screws at the top and bottom of each handle prevent it from working loose. A pair of padlock eyes are included with the set of latches.

The device can be used interchangeably on right- or left-hand doors, swinging in or out. It is made of heavy wrought steel.

New movie camera has simple mechanism

A Five-Pound Movie Camera

INVENTORS are busy these days perfecting motion-picture cameras for amateurs. A new one, weighing only five pounds, is held at waist level and when the operator presses a button, 20 feet of film is exposed.

After the pictures have been taken, by a special process the negative is changed to a positive and used for projection.

Ingenious Instrument Shows Position of Ship at Sea

FOR determining the position of a ship at sea, a retired Italian shipmaster, Signor Nuschak, has invented an ingenious instrument, which he calls the "arcometer." The arcometer is a mechanical model of the firmament. It consists of two circles (meridian and equator), mounted so as to move on axes at right angles to each other. The meridian circle is furnished with a semicircle representing the horizon.

At an angle of 90 degrees to this semicircle are two other semicircles (the hours).

All these arcs and circles are graduated. Two micrometrical screws, slow-motion tangent screws, and verniers are fixed at the base of the instrument. The verniers are equipped with enlarging prisms, to enable the navigator to make a reading in dim light.

ONE home burns every three minutes in the United States, according to the National Board of Fire Underwriters. Defective flues cause the most fires, with sparks on roofs a close second.

New Air-Pressure Suit Cures the "Bends"

WORKERS under air pressure are subject to the "bends." It is produced by a too sudden change of pressure and is due to the formation of small bubbles of air in the body, which press against important nerves. This peculiar caterpillar suit is the invention of a German, who claims that a man suffering from the "bends" can be placed inside the suit and air pressure applied up to the degree he has been working under. This relieves the distressed condition and then the air pressure can be lowered gradually.

Method of administering compressed air to sufferer from "bends"

Chicago Bank Employees Hold Fort against Bandits

TO FIGHT off bandits, a state savings-bank in Chicago has installed a miniature fort. A seven-foot semicylindrical steel plate set upon a rear balcony and camouflaged to look like a pillar serves as a turret. Through a small slot in this, an employee keeps a high powered rifle constantly trained on the bank floor below. The plate is armor for the watchman.

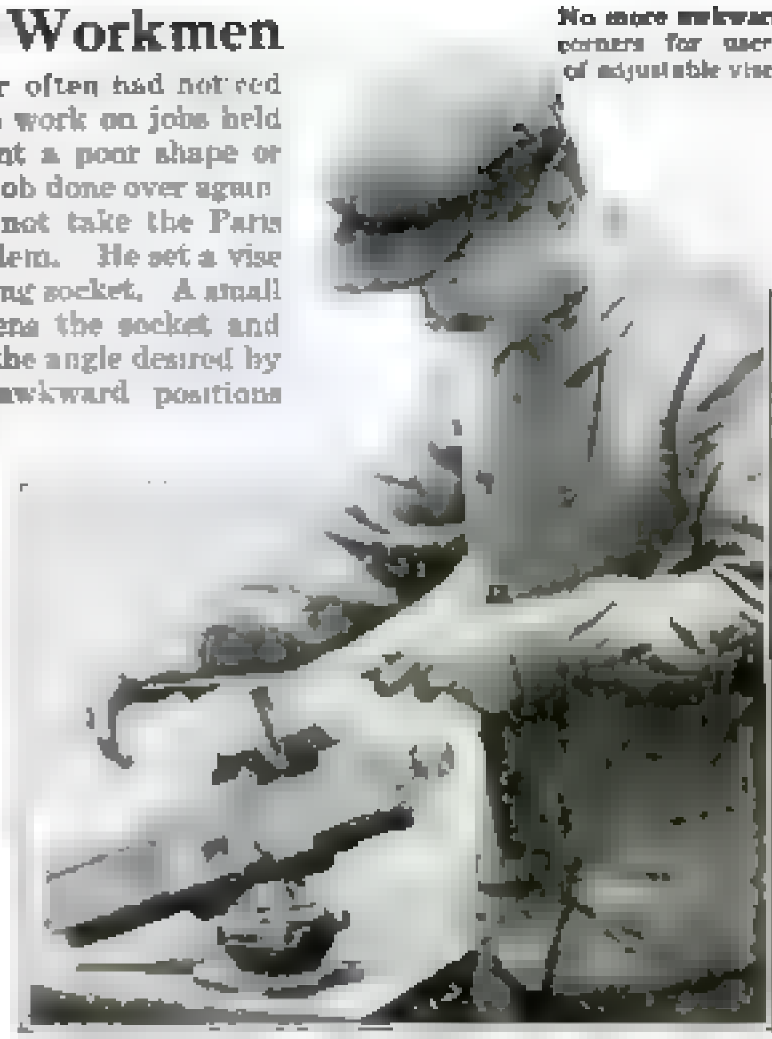
The photograph shows a junior employee standing guard. Besides this precaution, the bank has established a regulation rifle range in the basement, where all of the employees, including women, are taught to shoot. The bank has six rifles, a number of pistols, and electric buttons concealed in various places that will bring outside aid if the arsenal inside is not sufficient.

DISTEMPER has been traced to a germ similar to the typhoid-fever germ. The disease is very costly to silver-fox fur farmers, and experimenters are hoping that a remedy soon will be found to fight it now that the bacteria is isolated.

Movable Vise Aids Workmen

A CERTAIN Paris toolmaker often had noticed how awkwardly men had to work on jobs held in a vise. This sometimes meant a poor shape or finish to the work and perhaps a job done over again. What was the answer? It did not take the Paris toolmaker long to solve the problem. He set a vise on a ball base that fits into a spring socket. A small auxiliary vise on the side tightens the socket and makes it immovable, once set at the angle desired by the worker. By this means awkward positions at work are avoided and measurements followed easily.

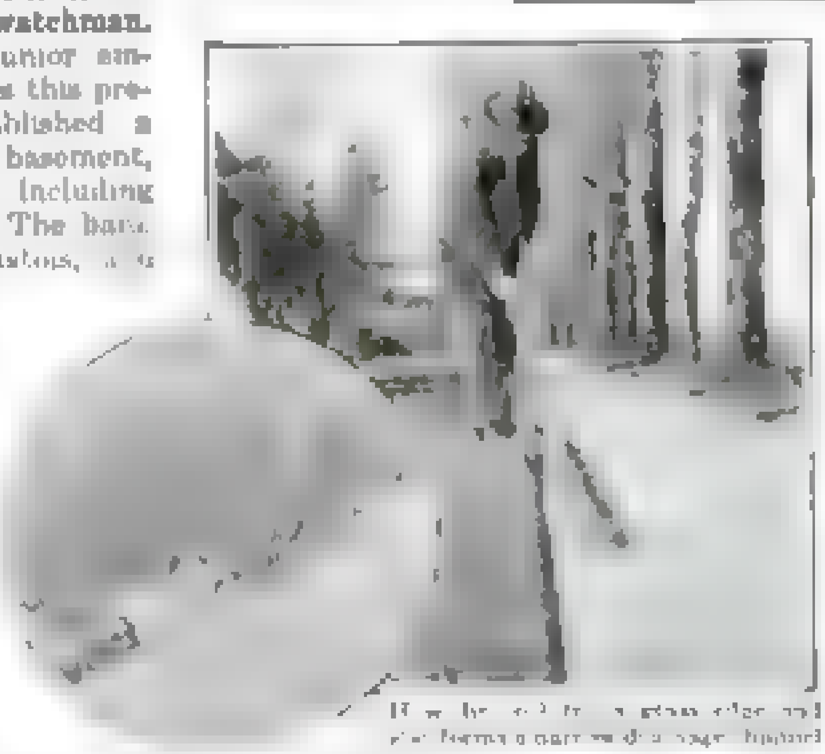
No more awkward corners for users of adjustable vises



How the new movable vise is set on its ball socket

LAYING 36,000 bricks a day, or 3½ carloads, James Brown, an Indian, formerly a football player at Carlisle, has amazed fellow workmen at Kansas City, Mo., who are convinced that he must be the world's champion bricklayer.

Five men are kept busy supplying him with bricks. He receives two dollars an hour for his labor, making $16 a day and says he believes he can even break this remarkable record when he has been at it awhile. He challenges any one to a bricklaying contest.



How the [illegible] edges and also forms a narrow drainage [illegible]

New Garden Tool Gives a Neat Finish to Lawns and Walks

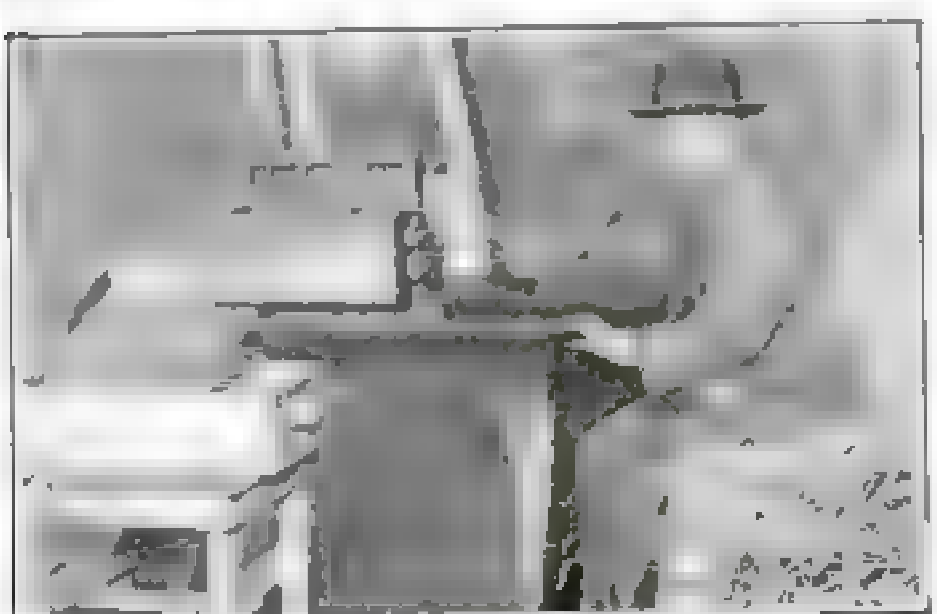
AFTER you finish mowing the lawn, there are still the edges to be trimmed along the walks. This is the most tiresome part of the whole job. Everything from a kitchen knife to a hoe is used to do the work and without very good results.

A new tool, easily operated, keeps the edges trim and clean. As it is pulled along, it cuts a narrow, even strip of the sod next the walk or curbing, leaving a shallow drainage groove, as shown in the illustration at the left.

FORTY dinosaur eggs have been found in Mongolia by the Roy Chapman Andrews expedition, according to cables received from the leader of the expedition. Fine dinosaur skeletons and skulls, arrow and spear points, old hearths and other archeological material, indicating a human culture of "dune dwellers" in the stone age, are other discoveries. Ten thousand feet of spectacular pictures have been taken.

Wire-Straightening Machine Salvages Junk

MASSES of tangled wire, often thrown away, may be salvaged in a new and unusual straightening machine. It will save 95 per cent of the wire put in it, it is claimed, no matter how badly twisted.



This straightening machine salvages 95 per cent of old wire

The wire is stretched over eight rolls made of tool steel. The first two act as pinching rolls, with spring adjustment to prevent shaft strain. The remaining six rolls are staggered. The shafts are made of high carbon steel. The machine will handle wire from one-sixteenth inch to three-eighth inch and from 150 feet to 200 feet a minute.

AFTER 15 years' research, a new wheat, said to be invulnerable to black rust, has been developed by R. S. McFadden, a South Dakota grain-grower. It is a mixture of hard red spring wheat crossed with the Emmer or Spletzstem, he says.

Mirror Switch Plate Will Fit Various Sizes of Switches

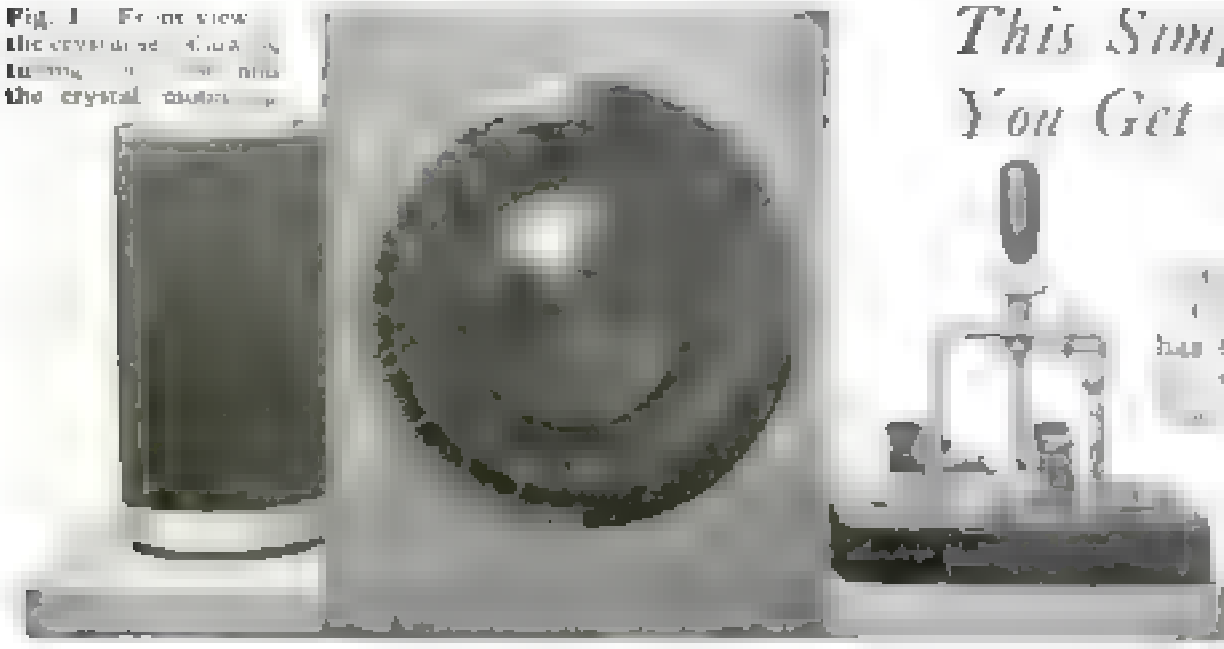
AN ECONOMICAL fixture recently put on the market is a mirror switch plate that fits various sizes of switches. It has a rectangular slot that permits the use of any standard square handle tumbler switch.

With a mirror backing, the plate fits in well with most decorative schemes, or plates can be obtained to match any color scheme desired for the home.

Placing new plate

How to Build a Crystal Set

Fig. 1. Front view ... the crystal set showing tuning ... and the crystal ...



This Simple Receiver Will Help You Get Started Right in Radio

By Alfred P. Lane

THERE are many millions of people in this country who live within five miles or less of a powerful radio broadcasting station. And, judging from the total sales of complete radio receivers and the parts from which to make them, a surprisingly large number of these people have not yet taken any interest in radio.

Building a simple crystal radio receiver is a mighty good way to get started in radio. You can build such a set at a minimum of expense and the upkeep cost is practically nothing. Then when you decide later to build a vacuum-tube radio receiver, the whole subject will be much less mysterious and difficult.

A friend of mine started in radio by way of the crystal-receiver route, and while he now possesses a remarkably good five-tube receiver, the old crystal set still is kept in commission and he uses it a great deal. He lives within a mile or two of one of our best broadcasting stations and when he happens to be alone at home and wishes to listen to the program from the local station, he dons the ear phones, adjusts the crystal until he finds a sensitive spot, and settles back in his armchair to enjoy the music while he reads the evening paper.

AS HE puts it: "Why should I wear out my tubes and use up my batteries just to hear station WXYZ when the crystal set brings in the music with perfect quality and the ear phones shut out all the street noises?"

The crystal radio receiver shown in Figs. 1 and 4 was designed and built to show how simply and easily a good set of this type can be constructed. No tools were used other than those to be found in every household, such as a small wood saw, a gimlet, a penknife, and a screwdriver. No soldering-iron was used and all the connections were made with the same wire used to wind the tuning coil.

Here are the parts of the set as indicated by letters on the illustrations.

A and *B*—tuning unit; *C*—variable condenser, .0005 mfd. (23-plate); *D*—crystal detector; *E*—fixed condenser, .0005 mfd.; *F*—wooden panel for variable condenser; *G*—wooden baseboard, 6 by 11 inches; four binding posts, dial for variable condenser, screws, etc.

You will have to buy about a quarter-pound of No. 22 double silk-covered wire for the tuning unit *A-B*, and of course you also will have to purchase the variable condenser *C*, the crystal detector *D*, the fixed condenser *E*, and the binding posts and dial for the condenser.

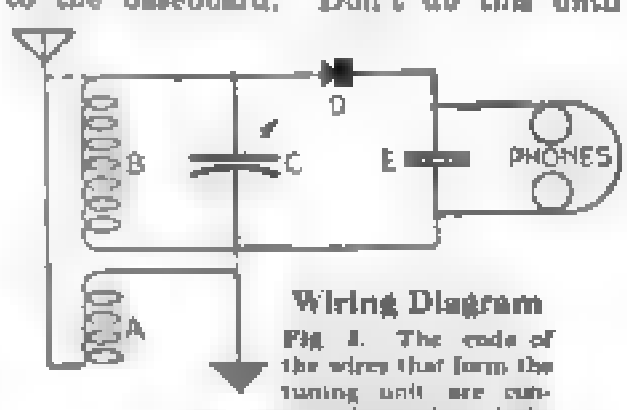
It is a mighty good idea to buy a really good variable condenser and dial, because these parts can be used later in a vacuum-tube receiver. Get a dial of standard make so that you will have no difficulty in matching it if the vacuum-tube design calls for more than one dial.

THE rest of the parts can be of low-priced type and of course the baseboard and the panel for the variable condenser can be cut out of an old packing-case or any stray half-inch board that happens to be handy.

The tuning unit *A-B* is wound on a piece of cardboard tubing two inches in outside diameter and four inches long. There is no magic in this particular size, however. You can use smaller or larger tubing if it happens to be convenient, although you will have to change the number of turns of wire to correspond. The larger the tubing, the lower the number of turns of wire needed. Cotton-covered wire or enameled wire can be used if you prefer. Use more turns with cotton-covered and fewer with enameled wire.

Coil *A* consists of 30 turns of wire and coil *B* has 45 turns. The number of turns in coil *B* is determined by the variable condenser you use. The number of turns in coil *A* on the other hand, should be adjusted so that you will get the proper degree of sensitiveness and selectivity, and these factors are in turn governed by the distance from the broadcasting station and the size of your antenna.

Two small holes are punched through the cardboard tubing at the point where each coil begins and ends. The coils are wound as close together as convenient. The end of the wire is passed in one hole and out the other, leaving a long end that can be connected directly with the other instruments. The completed coil is held in place by a small brass right-angle bracket in the model receiver, but it is equally satisfactory to glue the end of it to the baseboard. Don't do this until you are sure that you have the windings right for your particular conditions.



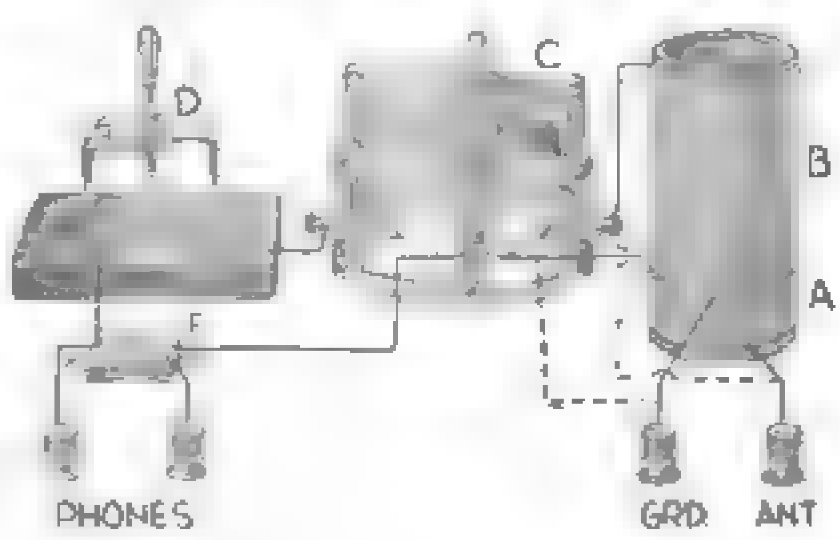
Wiring Diagram

Fig. 3. The ends of the wires that form the tuning unit are connected directly with the binding posts of the other parts. No soldered joints are used

IF YOU are very close to several broadcasting stations and you can put up a long outdoor antenna, you may have to cut down the number of turns in coil *A*. I would suggest that you wind the specified number and then take off turns until you can separate the different broadcasting stations.

Perhaps you are as much as five miles away from the nearest station. In that case you should increase the number of turns in coil *A*, or you can decrease the number of turns in coil *B* and connect binding posts Nos. 1 and 2 directly with the ends of coil *B*, thus eliminating coil *A* altogether. How to do this is shown in dotted lines in Fig. 2.

The reason for decreasing the number of turns in coil *B* when coil *A* is eliminated is because in the latter case the antenna and ground become part of the tuned circuit and their capacity is added to that of the variable condenser *C*. Eliminating coil *A* also is desirable if you have to use a



Pictorial Wiring Diagram for Beginners

Fig. 2. Dotted lines indicate connections when very short antenna is used or when broadcasting station is far away

short antenna of, say, 40 feet or less. You cannot expect to get good reception with any crystal set, however, on such a short antenna unless you are within a mile of the broadcasting station.

I AM giving these possible variations so that you can adapt the crystal set to your own particular needs. If you are in doubt about how to do it in your own case, I shall be glad to advise you if you will let me know the actual distance to the nearest broadcasting station and the length and height of antenna you can put up.

After the coil *A-B* is wound, study Figs. 1 and 4 and mount the rest of the instruments as shown.

The wiring is extremely simple. The wire from the upper end of coil *A* goes to binding post No. 2 and the other wire from coil *A* goes to binding post No. 1. Then scrape off the insulation on the wire from the lower end of coil *B* so that you can connect it with the binding post that is on the metal framework of the variable condenser *C*. This wire continues to one side of the fixed condenser *E* and then to binding post No. 3.

Now connect the top end of coil *B* with the binding post on condenser *C*, which is fastened to the stationary plates of the condenser. Many types of variable condensers have a binding post at each end of the stationary plates. If yours is of this type, connect the other binding post on the stationary plates with one terminal of the crystal-detector stand.

COMPLETE the wiring by connecting a wire from the other terminal of the crystal detector stand with the remaining terminal of fixed condenser *E* and continue it to binding post No. 4.

The antenna should be as long and as high as you can get it and should be insulated at every point where it touches any support. Connect it with binding post No. 1. Then connect binding post No. 2 with the nearest cold water pipe.

The head phones should be connected with binding posts Nos. 3 and 4. Buy good head phones. The quality of your reception depends on them and they always will be useful, even with a vacuum-tube set, for tuning in distant stations and for listening in late at night when you do not want to disturb the neighbors by running the loudspeaker.

Most head phones are adjusted so that they will clamp tightly on the smallest size of head. You will find much more comfort in wearing them if you will bend the frames very carefully until they will just stay in place on your ears. Additional comfort may be secured by bending the headbands so that they touch your head evenly for several inches instead of just at one or two spots.

To get the set into operation after everything is connected properly, check up the radio program in your daily paper and make sure that the station you want to hear actually is broadcasting. Place the head phones on your head and with one hand turn the dial of condenser *C* back and forth very slowly, while with the other hand lightly touch the fine wire, called the "catwhisker," to the surface of the crystal at various points. Eventually you will find a sensitive spot and you will hear music or speech in the head phones.

JUST as soon as you hear the faintest sound in the head phones, stop adjusting the crystal detector and turn the dial of condenser *C* until the signal is as loud as possible. Then let the dial alone while you readjust the cat whisker until the music or speech is as loud as possible. The next step is to write down on a piece of paper the number on the dial at which the signal is being received.

The crystal will stay in adjustment for as much as several days at a time if it is not accidentally jarred out of position. It is well, therefore, to locate the receiver where you are not likely to strike it with your arm in moving about the room, and it also is worth while to set the whole outfit on a soft pad of cloth to take up vibrations that may be transmitted to it from the table.

You will find there is a great difference in the sensitiveness of different crystals. Some are very much better than others. As a general rule, the fixed type of crystal detector is not so sensitive as those in which an adjustment can be made to find the extremely sensitive points.

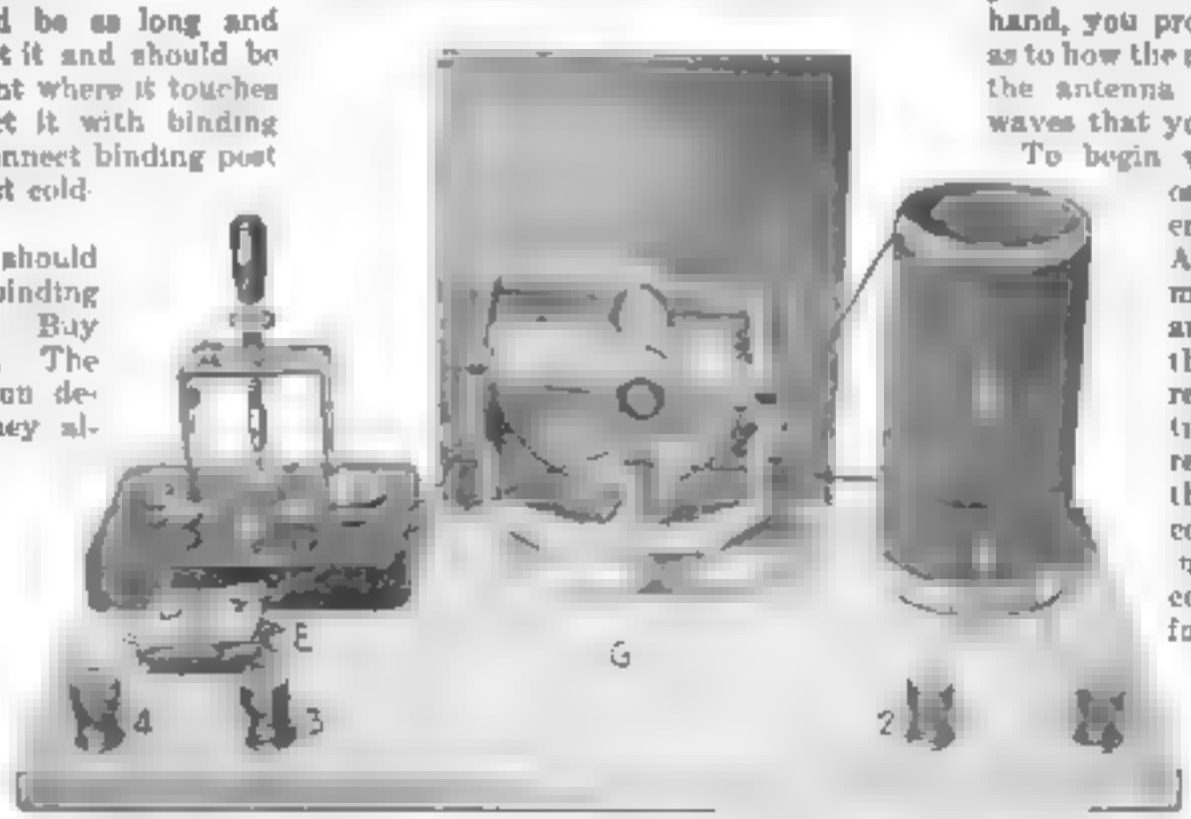
WHEN you finally locate a really sensitive crystal, it should be treated carefully. Protect it from dust and do not handle it with your bare hands. Use pliers to pick it up or use a piece of dry cloth over your fingers.

Since this crystal radio receiver will be your first introduction to radio at first hand, you probably will be a bit curious as to how the radio signals that come down the antenna are converted into sound waves that you actually can hear.

To begin with, the radio waves are oscillating back and forth at enormously high frequencies. At a wave length of 200 meters they are sliding up and down your antenna and through the *A* coil of your receiver at a rate of 1,500,000 times a second. This current, moving back and forth through the wire in the *A* coil, sets up a rapidly changing magnetic field about the coil and the changing lines of force cut through the turns of wire in the *B* coil and induce a current in them. This current in turn flows back and forth through the wires of coil *B* to the plates of variable condenser *C*.

Turning the dial

(Continued on page 144)



How to Assemble the Parts on Baseboard

Fig. 4. This view shows how to assemble the instruments on the baseboard and wooden panel. Note that the connections from binding posts to the fixed condenser *E* are made by means of 6-32 brass screws passed through the holes in each eyelet as illustrated

The Popular Science Institute of Standards Tells

When *a Radio Coil* Is "Low Loss"

By Alexander Senauke, M.E., E.E.

EVERY radio fan who buys or builds a radio receiver is interested vitally in the tuning coils used in the set, for the efficiency of these parts determines, to a very large extent, the selectivity and distance-getting ability of the outfit.

All sorts of tuning coils have been recommended by various radio engineers and experimenters. One authority maintains that the spider-web type of winding is the best. Another is equally sure that a plain, cylindrical coil has more advantages. And so it goes, with new types of coils appearing on the market, each one claiming to be a marked advance over its predecessors.

Sometimes the new coil actually is better. This is usually the case when the design is the result of intensive research work by competent engineers. But unfortunately, there are many coils that are produced solely to catch the eye of the radio-set builder.

Then, too, the sharp tuning qualities of a radio coil are influenced to a great extent by the other parts in the receiver. This means that a coil that shows up well on the test bench may not give as good results when built into a receiver because the other instruments in the set may be mounted in the wrong position with relation to the magnetic field of the coil.

The characteristics found in every tuning coil and that determine its efficiency are:

1. Its inherent resistance or the actual resistance of the winding to the passage of radio-frequency currents.

2. Its distributed capacity, or the electrical capacity of the turns of wire, one with another, which permits the current to flow across the coil instead of through the wire. This effect runs up the apparent resistance of the coil and reduces the wave-length range that can be covered with any given variable condenser.

3. Its stray magnetic field, which also increases the apparent resistance by permitting energy to be lost through the generation of waste current in the metallic part of neighboring apparatus. This property of tuning coils is highly important, for it is the cause of feed-back and howling and often causes a coil to show up very poorly when it is used in a radio receiver.

Bearing those facts in mind, we can say safely that a tuning coil for use in modern radio receivers should have

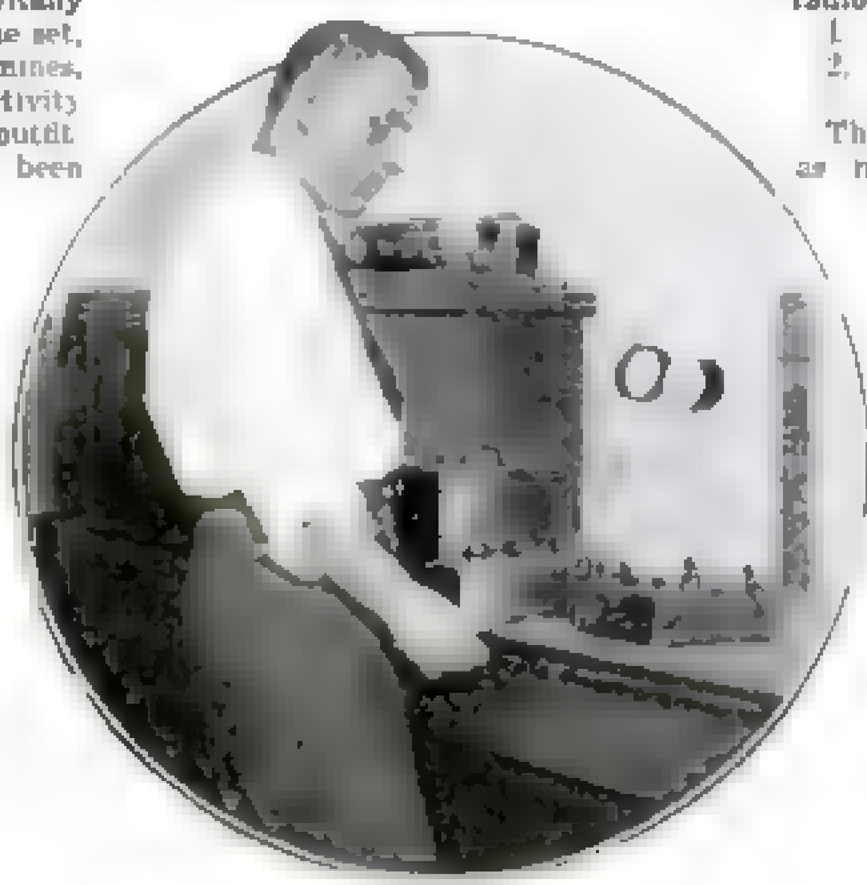
1. Low resistance.
2. Low distributed capacity.
3. A concentrated magnetic field.

The effective radio-frequency resistance as measured in the Popular Science Institute of Standards Radio Laboratory, includes the sum of the first two causes of coil inefficiency, but does not take into account the stray magnetic field, because laboratory measurements always are made with the coil well separated from any object that might influence its action.

The radio-frequency resistance of a coil depends, also, on the diameter of the coil and the number of turns of wire in it. This means that a coil designed to cover the broadcast range of wave lengths when used with a .0005-microfarad variable condenser (23-plate), naturally will have a lower resistance than another coil of the same type that has sufficient wire to cover the broadcasting range with a smaller condenser.

The inductance of a tuning coil is measured in microhenries and the effective resistance is measured in ohms. In our test work we use a figure of merit that allows us to compare coils of different sizes. This figure of merit is the ohms resistance to each microhenry of inductance.

The accompanying table shows some of the results of tests on various types of tuning coils now obtainable in the open market. These tests show only the effective resistance of the coil when supported in the air at some distance from any other instruments. The figures indicate, therefore, the relative value of the coils only when they are used in large radio sets.



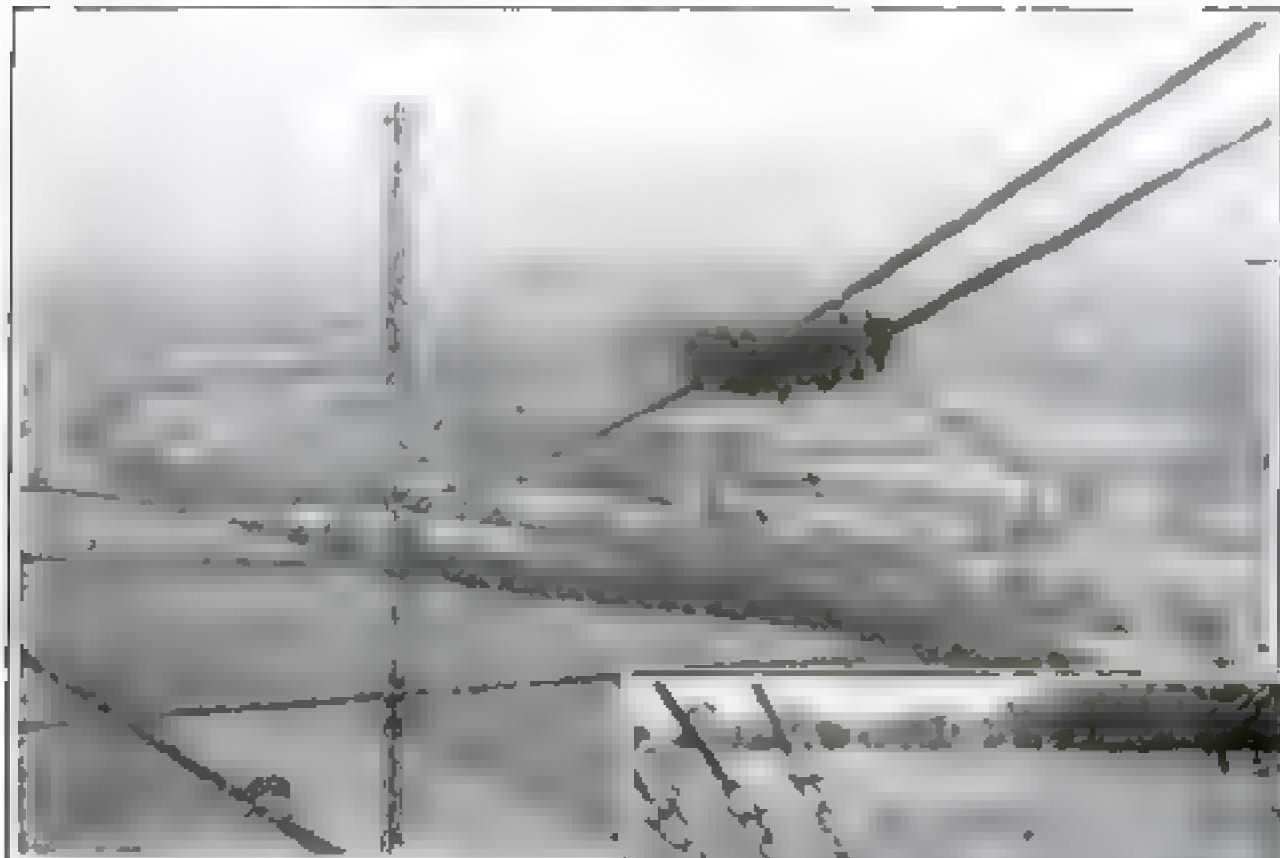
Testing Coils at the Institute

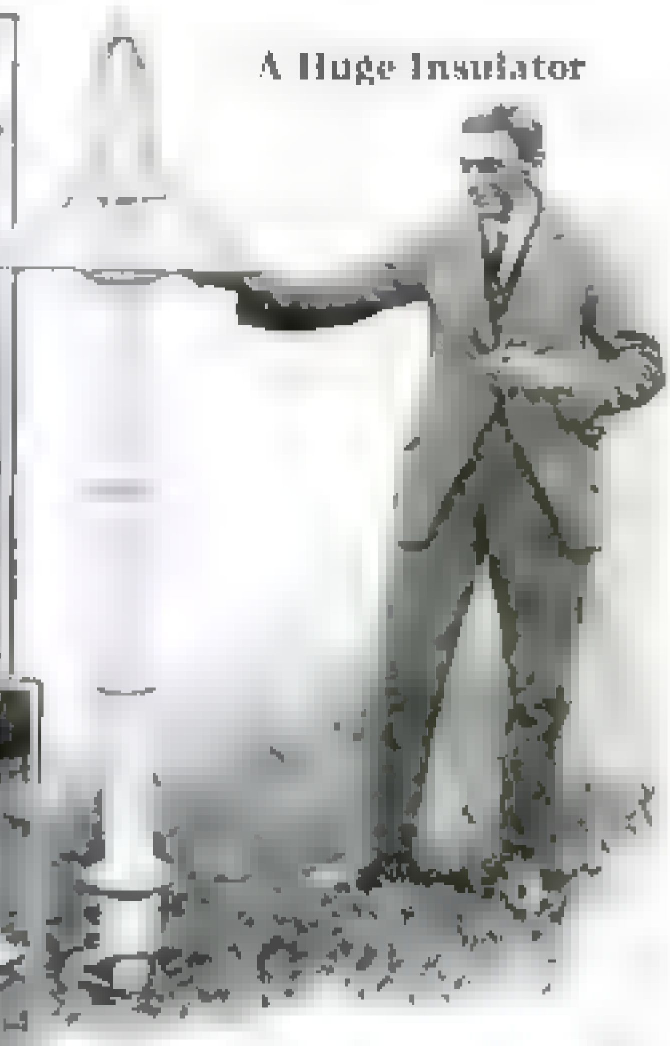
Note that the coils are suspended in midair by means of strings. This is in order to eliminate the effect of stray magnetic field

Coil No.	Description and type of winding	Diam.	Length	Wire size and Insulation	Inductance in microhenries	R.F. Resistance at 500 Meters	R.F. Resistance at 400 Meters	R.F. Resistance at 300 Meters	Average R.F. Resistance	Figure of Merit Resistance per Microhenries
1	Single-layer solenoid on [illegible] bakelite tube	3 in.	1 5/8 in.	No. 22 d.c.c.	154	5.0	4.0	5.4	4.8	.027
2	Same	3 in.	1 5/8 in.	No. 22 d.s.c.	153	6.4	3.2	4.3	3.5	.015
3	Single-layer solenoid supported on bakelite frame with 4 cross ribs. No binding material	3 in.	2 1/2 in.	No. 22 d.c.c.	246	7.6	5.7	4.3	5.9	.024
4	Single-layer solenoid staggered adjacent turns, with binding compound at crossings, no supporting [illegible]	3 in.	[illegible]	No. 22 d.s.c.	284	6.9	7.0	5.4	7.1	.025
5	Single-layer solenoid spaced half diam. of wire on celluloid film	3 in.	[illegible]	No. 22 s.s.c.	[illegible]	7.6	5.5	4.3	5.8	.021
6	Single-layer solenoid on skeleton hard-rubber tube	[illegible]	[illegible]	No. 26 d.c.c.	154	7	5.6	4.2	5.7	.031
7	Multi-layer honeycomb on [illegible] bakelite frame	[illegible]	[illegible]	No. 24 d.c.c.	[illegible]	15.8	[illegible]	13.4	16.6	.063
8	Pancake, self-supporting, on three wooden pegs	Inside 2 3/4 in. Outside 3 [illegible]		No. 24 s.s.c.	340	21.0	18.6	13.0	17.5	.052
9	Double-coil construction of two coils in series winding spaced on celluloid film	[illegible] in. each	[illegible] in. each	No. 30 s.s.c.	290	19.3	15.8	12.3	15.8	.055
10	Complete toroid staggered adjacent turns, molded skeleton supporting frame	Outside 4 [illegible] in. Inside 2 [illegible] in.		No. 22 d.c.c.	180	11.6	9.6	8.2	9.9	.055
11	Lorenz basket, self-supporting	4 in.	1 3/4 in.	No. 18 d.c.c.	182	6.0	4.3	3.4	4.6	.025

Some New Marvels of Radio

How Mystery Waves Are Harnessed for Greater Uses





A Huge Insulator

Five-Hundred-Foot Masts

The remarkable view above shows the top of one of the 500-foot antenna masts for the powerful new broadcasting station at Daventry, England. This station is equipped to operate [illegible] watts on a wave [illegible] meters. Wind pressure against masts and antenna is so great that special [illegible]. It is [illegible] Stations [illegible] special [illegible] hear the broadcasting from Daventry

Guy wires for the masts are fastened to [illegible] anchors weighing 60 tons

One of the gigantic insulators used at the Daventry broadcasting station compared with a [illegible]. They are approximately six feet in length

Giant Tubes for Station WPL

Below is an excellent view of the transmitting tubes now being used by Station WPL of New York City and other broadcasting stations licensed to transmit on high power. The tubes are water cooled, since otherwise the intense heat they give out would destroy the elements

Radio Car Will Cross Continent

A New York auto dealer now is experimenting with an automobile that is controlled entirely by radio impulses from another car. The [illegible] control [illegible] shown above [illegible]. At the [illegible] the [illegible] patented system of relays used to actuate the steering mechanism, gears, and also the brakes

Apparatus that controls driverless car

Breaking in Your New Set

How to Install It for the Best Possible Radio Efficiency

By John Carr

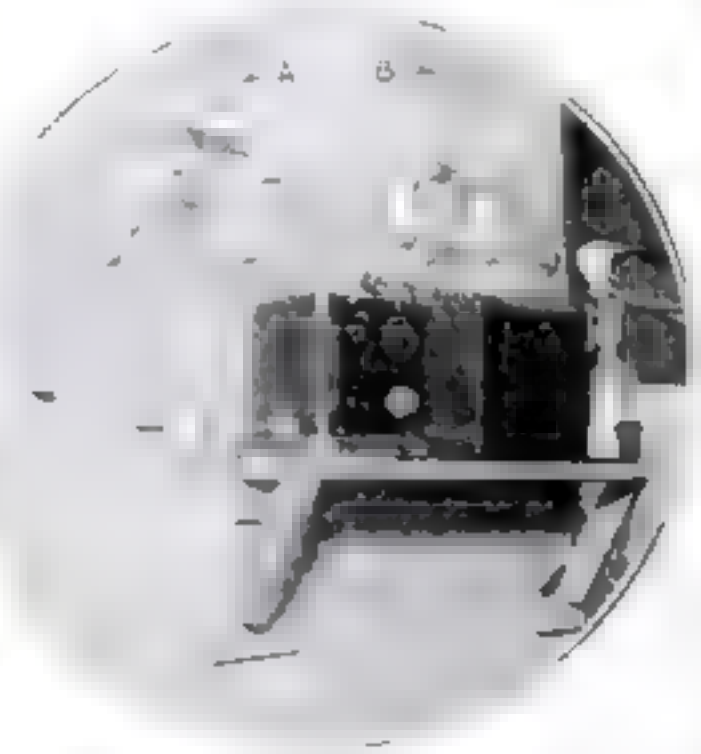
Useful Hints that Will Help to Solve Beginners' Problems

PERKINS, who lives [illegible] dropped in a few [illegible] and asked me to "[illegible]" to his house for a minute."

I noticed that the living-room was lighted more brilliantly than usual and the reason for the bright light and the call for help was quite apparent as we stepped into the room.

In the middle of the [illegible] was a huge cardboard packing-case with the name of a prominent radio manufacturer printed in large letters on the side. Surrounding it were smaller packages. Evidently my friend had decided to become a radio fan, and while he was about it had purchased a complete outfit. Aside from the radio receiver itself, there were a storage battery, several blocks of dry-cell B batteries, a loudspeaker, antenna equipment, and a lightning arrester, also several knife switches and a coil of wire for making connections.

This [illegible] gave the best [illegible] of a bookcase to a [illegible] of the living-room



In this cellar installation, the **A** batteries light the filaments of the receiver and ring the doorbell. Wires marked *A* above the battery run to the receiver and those marked *B* to the bell

"NOW that I've bought it," said Perkins helplessly, "I can't for the life of me figure out where to put it all. The wife will have a fit if I muss up the living-room with a lot of unsightly wires and things. What'll I do?"

Thousands of men have stood in Perkins' shoes; for there is no question that the proper installation of a radio receiver often presents a real problem. Frequently a compromise has to be made between efficiency, appearance, and ease of operation to keep peace in the family.

As for Perkins' set, we finally decided to put the receiver on a table in the living-room, run wires through a hole in the floor to the batteries in the cellar, and place the loudspeaker on a bookcase near by

If you are living in an apartment, where everything must be kept on the same floor, you cannot put the batteries in the cellar. A good way to do in such a case is to purchase or construct a radio-cabinet stand that includes a compartment for the batteries. Another way is to hide the batteries behind some near-by piece of furniture or in a closet.

Aside from appearance and the necessity for locating the receiver near the best place to connect with the lead-in wire, the question of light is important. You must place the receiver where the lights already in the room will shine on the tuning dials; or else install a special drop-light near the set.

Fortunately, the loudspeaker can be installed wherever you want it without regard to the position of the receiver itself. This is because the volume and tone are not affected by the length of wire between set and loudspeaker. It is possible, therefore, to locate the receiver in the cellar, attic, or kitchen and still enjoy broadcasting in the living-room. The only disadvantage of such an installation is the inconvenience of retuning if you decide to listen to the program from another station rather than the one for which the receiver is adjusted.

THERE is one real advantage in placing the loudspeaker some distance from the radio receiver. Such an arrangement positively prevents any chance for howling and humming noises, which sometimes are produced by actual mechanical vibrations set up in the elements of the tubes by the waves of sound from a loudspeaker that is too near by

The location for the receiver decided upon, the next step is the erection of a suitable outdoor antenna. Of course, theoretically, there are perfect methods for erecting an antenna, but the average radio fan is so bound about by the physical limitations of the location, that his antenna probably is far from perfect anyway.

YOU can be satisfied that you have the best antenna possible if you get it as high as possible and as long as you can up to 100 feet. This does not mean that you should erect a 50-foot pole. It is sufficient to fasten the far end of the antenna to the highest natural support available. The chimney of your neighbor's house, the water tank on the top of the apartment house, or similar natural high points usually are suitable. As far as insulation is concerned, all you need remember is that no part of the antenna or the wire that leads down from it to the receiver should touch anything but insulating material until it reaches the binding post. In-

(Continued on page 1-9)

New Auto Equipment

These Ingenious Accessories Will Add to the Car-Owner's Enjoyment

Soft Yarn Mop

Fitting on the end of any hose, this auto mop, made of absorbent yarn, is said to be absolutely harmless to the finest enamel finish. It will not scratch, because of its soft texture and because it is saturated from the sides, flushing dirt and grit in its path

It Eliminates Glare

This little rubber circle with its amber glass center (below) will shield your eyes from the sun or the blinding glare of a headlight at night. It is held to the windshield by suction

Motorist's Khaki Cover-All

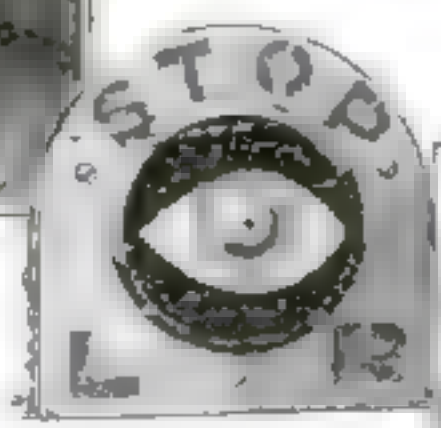
This garment can be put on like a coat. It buttons up in front and the legs are fastened by clasps. It is made of a khaki material that will fold up easily and go in the toolbox, or it can be worn when driving over dusty, sandy, or muddy roads

New Rim Tool Will Fit Toolbox

By means of the setscrews in the jaws of this rim tool, a tire rim is held with a firm grip. One movement contracts the rim and holds it in position until the tire is replaced. The tool will fit easily into the auto toolbox

Simple Car-Heater

The manufacturers of the ingeniously simple heater shown above claim that "just a pipe to cut a notch to make, and three small holes to drill" is the only work required to install it in any motor-car. It runs parallel with the steering rod and is fed from the engine exhaust pipe. The illustration shows how temperature is regulated by an adjustment lever controlling a valve



The "Flirt"

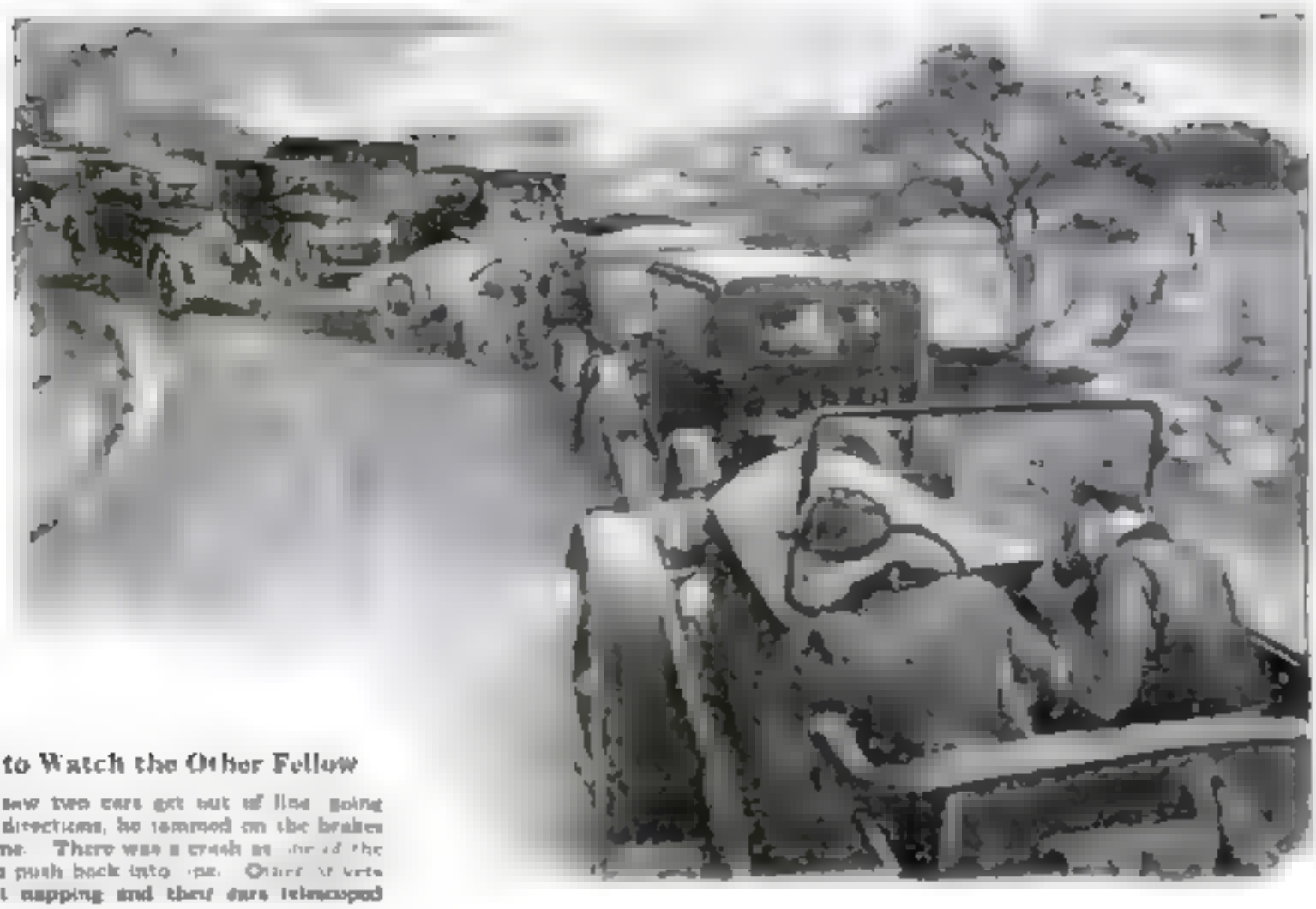
It may be an amusing stop signal, but it is almost sure to attract the attention of the driver behind. When the car is stopping the eye rolls in the direction the driver is intending to turn. At night it is illuminated, serving also as a tail-light

Grease Container

A novel and inexpensive grease container is made of stiff cardboard. It is shown above being used to fill a grease gun. Turning the base of the tube ejects its contents. A small screw top keeps the contents airtight

Thermostatic Control

No more stalled engines due to cold weather, say the makers of the thermostatic water control shown at the left, which keeps the engine at the most efficient running temperature all year and requires no carburetor adjustment



It Pays to Watch the Other Fellow

When Gus saw two cars get out of line going in opposite directions, he rammed on the brakes —just in time. There was a crash as one of the cars tried to push back into line. Others motorists were caught napping and their cars telescoped

When Foresight Saves a Crash

Gus and Joe Go Hunting and Dodge Foolhardy Drivers

By Martin Bunn

"DOGGONE!" exclaimed Gus Wilson, half owner and chief mechanic of the Model Garage, as he piloted his automobile to the rear of the line of cars that was creeping along toward the railroad crossing. "No matter how early in the morning a fellow starts out, there's bound to be a bunch on the road ahead of him!"

Joe Clark, Gus's partner, the office man of the combination, settled himself a little more comfortably in the roomy front seat of Gus's ancient and honorable machine.

"Huh!" he grunted with a sly grin. "What do you expect on Election Day? Of course there'd be people on the roads. This isn't your private holiday."

"I know all about that," growled Gus. "But you'd think some of them would learn how to drive before they come out. Look at that dumb-bell down the line there. Wonder how he expects anybody to get past him, crowding in that way?"

"He's probably like you—in a hurry to go rabbit shooting," suggested Joe teasingly. "The trouble with you hunting bugs is—"

Joe got no further, for at that instant—and apparently for no reason at all—Gus jammed on the brakes so suddenly and so forcibly that his partner was caught unawares and almost catapulted through the windshield.

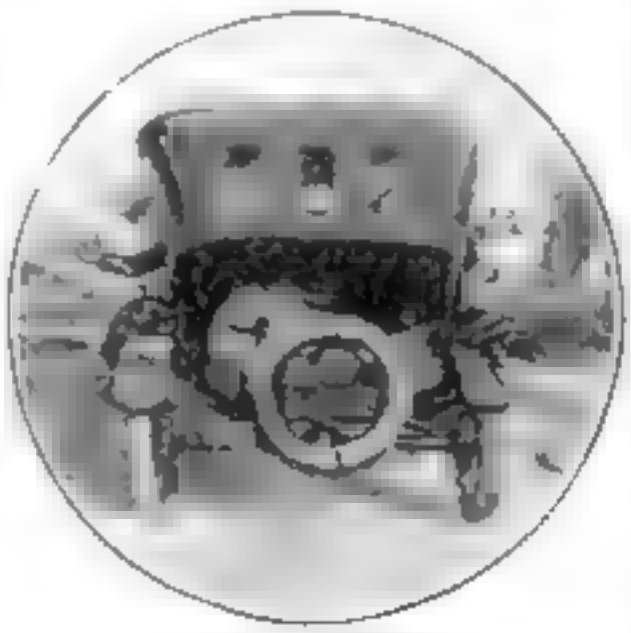
"HEY!" he protested, as he tried to regain his balance. "What in blazes are you trying to do?"

Before Gus had time to reply, there came a piercing scream and a grinding crash, followed immediately by a series of minor crashes as the cars ahead of the two garagemen telescoped into each other like a lot of freight-cars when a powerful locomotive takes up the slack in a train.

Gus's car had been only a few feet behind the car in front, but by applying the brakes so suddenly, Gus had succeeded in dropping back a full 20 feet before the crash came, and now—with locked wheels—his car skidded to a halt without quite bumping the car ahead.

"Gosh!" panted Joe. "That was a close call. How did you know there was going to be a smash-up?"

"By keeping my eyes open," replied Gus a bit gruffly, as they joined the crowd of pale and nerve-shaken motorists



Like a Centipede

You have seen them—a bunch of hands stuck out all together and so two hands pointing in the same direction. "Let the driver do all the signaling," says Gus

who were standing about the damaged cars at the front of the line. Miraculously enough, nobody had been injured seriously, in spite of the quantities of broken glass that had been flung in every direction.

THE motorist who had caused the smash-up was surrounded by the owners of the cars that had piled up behind him, each one shouting angrily in an attempt to make himself heard above the hubbub.

Just as the argument seemed about to turn into a free-for-all fight, a motorcycle policeman appeared.

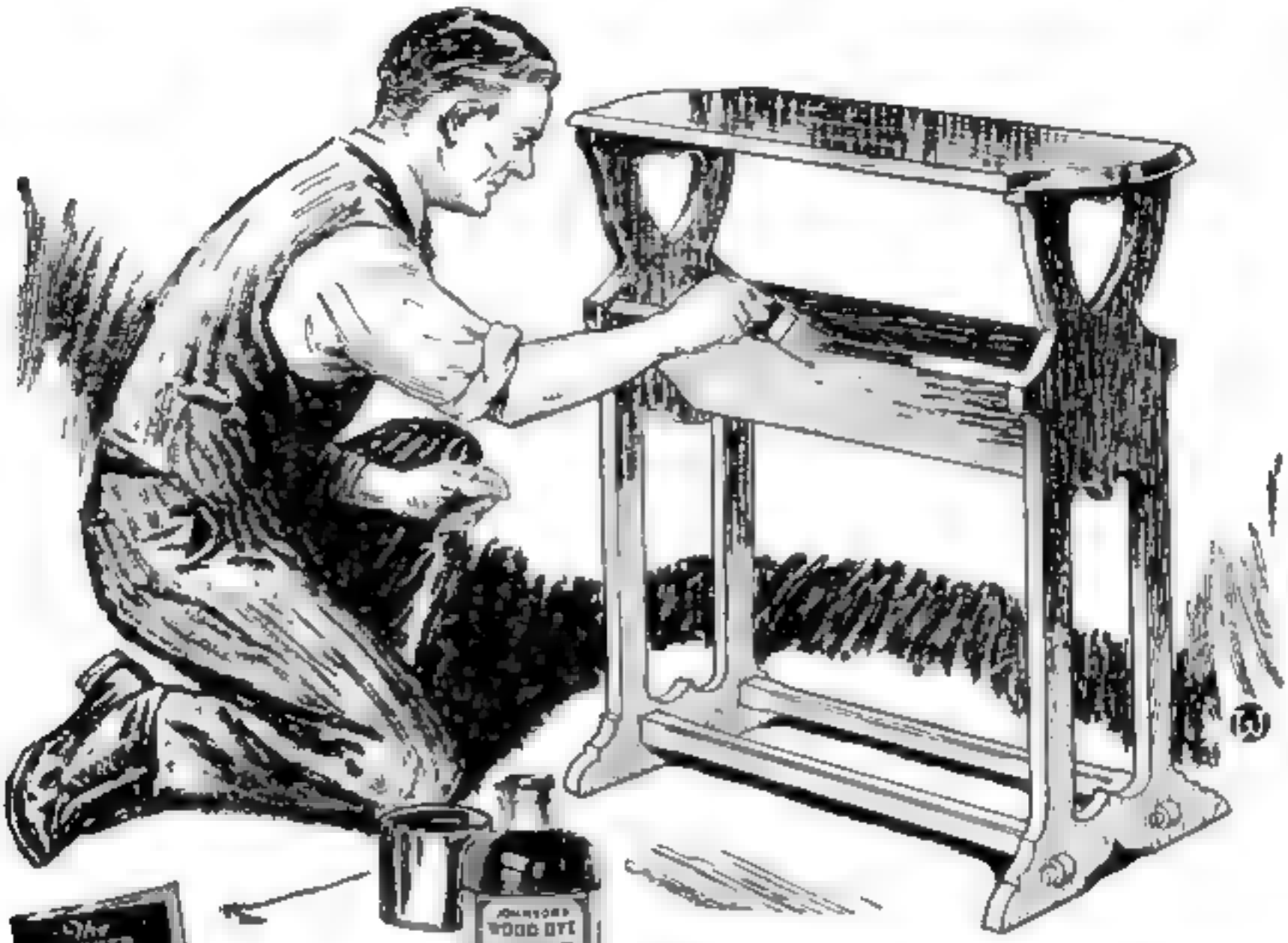
"Speaking of dumb drivers," said Gus, after the officer had restored quiet and the cars were moving again; "you remember that bird who pulled up along the line while we were waiting? Well, the road at the crossing is wide enough for three cars abreast, so the single file of cars coming the other way could get past. But when a fellow coming the other way tried to get out of line, that made four cars—and right then I slammed on the brakes. Our dumb-bell friend tried to get back into line when he saw the other car coming. But there wasn't any space to push into because the rear car could not drop back quick enough. They crashed, and the drivers ahead were caught napping."

"WHICH only goes to show," said Joe, "that the right time to pass a car is something lots of drivers don't know."

"Humph!" Gus grunted. "There's more to it than that. The drivers of the

(Continued on page 159)

How to Give Furniture a Beautiful Finish



For a blue print of this attractive combination Book Rack and End Table send us 25c in coin or stamps.

The Johnson Book gives complete instructions for finishing new and refinishing old wood soft or hard. This book is the work of experts —beautifully illustrated in color. Ask for a free copy at your best paint or hardware store.

Stores displaying the above sign carry a full line of Johnson's Artistic Interior Finishes. They will give you a free copy of the Johnson 25c Book on Home Beautifying and are competent to answer questions and give advice on the proper finishing of wood. These stores will gladly show you panels of wood finished in many beautiful effects.

AFTER spending precious hours making furniture by hand you naturally want to give it a beautiful finish. And surely the finishing should receive its share of attention, for a beautiful piece of furniture may be ruined if improperly finished, whereas any small defects are minimized in a well-finished piece. So the finishing of your furniture becomes a matter of prime importance.

First apply a coat of Johnson's Wood Dye. With this you can color the wood any one of 17 beautiful shades. Johnson's Wood Dye is very easy to apply -it dries in four hours and will not rub off or smudge. Penetrates deeply, bringing out the beauty of the grain without raising it.

Open grained woods (oak, chestnut, ash, mahogany, walnut, etc.,) should then be given a coat of Johnson's Paste Wood Filler followed by a light coat of Johnson's Under-Lac or pure white shellac. The furniture is then ready to be finished—either with two coats of Johnson's Prepared Wax or Johnson's Varnish. For close grained woods (pine, cypress, maple, birch, etc.), omit the Filler coat.

Follow these instructions for finishing furniture and you will be assured of perfect results —the thrill of pleasure when the work is new and yearly satisfaction at its wearing qualities.

S. C. JOHNSON & SON, *"The Wood Finishing Authorities"* RracINE, WIS.

JOHNSON'S WOOD DYE

Some New Ideas for the Motorist

Half a Dozen Ways to Save Money on Your Automobile

IN STEADY driving, the motorist's left foot is used only to work the clutch occasionally and this idle foot can be used very well to operate the windshield wiper by the arrangement shown in Fig 1. Two ordinary hand-operated windshield wipers are clamped on the windshield with a coilspring at the right attached to the arm of the right-hand wiper. Then a simple pedal is placed on the floorboard next to the clutch pedal. This pedal can be made of a small piece of wood hinged to the floorboard.

At the left end of the windshield a small pulley is fastened and a cord run from the pedal through the pulley and to the left and then the right wiper arms. Pressing down on the pedal pulls both wipers to the left and the spring pulls them back across the glass when the foot is lifted from the pedal.

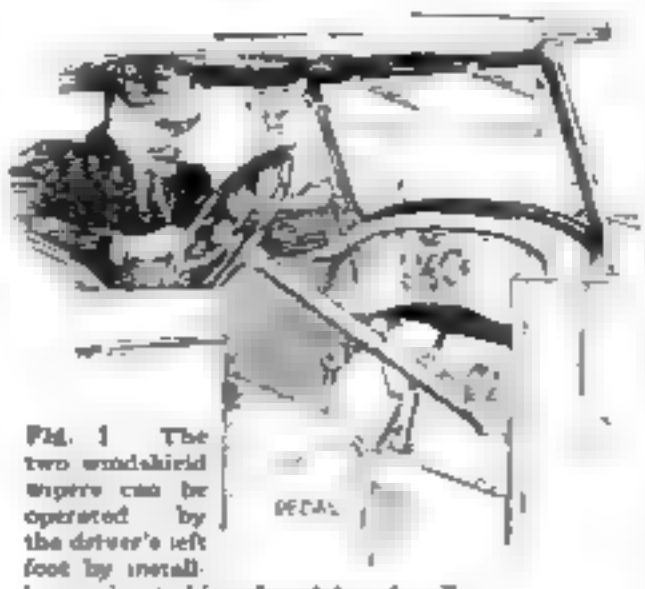


Fig. 1 The two windshield wipers can be operated by the driver's left foot by installing a simple hinged pedal and pulley next the clutch pedal of your car

SOME auto-drivers are under the impression that a car can be driven home when the front spring breaks, simply by blocking up the axle with a piece of wood. This is true if the long leaf that holds the spring-shackle bushing remains intact; but if every leaf is broken, the flexibility of the shackle at the rear of the spring will allow the axle to move back under the car so far that steering will be difficult if not actually dangerous. As Fig. 2 shows, a clamp and an extra spring leaf used in conjunction with the wooden block will bring you home safely.

Fig 2. An emergency repair for a broken front spring

A TORN celluloid window plus a few rents in the material itself will make the back curtain of a car very unsightly. Of course, a simple remedy is to buy a new curtain, but some owners will prefer to do the work themselves.

Figure 3 shows how this was accomplished by an auto-owner who takes great pride in doing a neat job. After the new curtain material was tacked in place, he held the wooden frame in the position to be occupied by the rear light and cut the curtain material as shown in the upper part of the illustration. The lower part shows the details of the frame that held the glass in place. If a celluloid window is to be used instead of glass, a good stunt is to cut the window the shape desired, sew a strip of material around the opening, and sew in the celluloid with a bobbin and black tape. The holes in the celluloid should be punched with a paper punch. Then if the celluloid cracks or tears, a new window can be made in a few minutes.

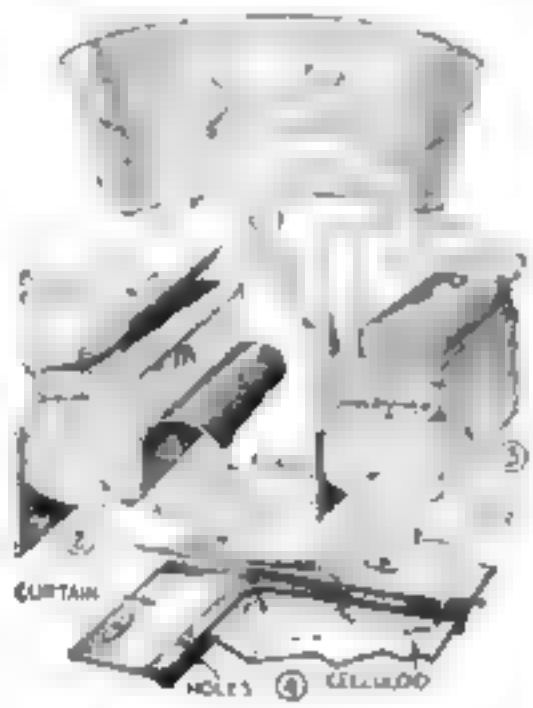


Fig. 3. How one man set up and made a new back curtain for his car

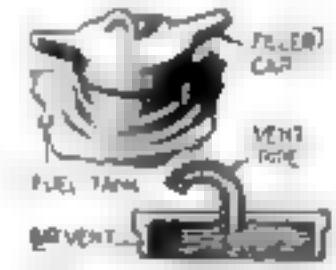


Fig. 4. Small bent pipe on gasoline tank cap keeps out dirt

THE most common cause of trouble with the gasoline supply system is clogged pipes, due to dirt or scale from the tank. Such trouble usually is found easily enough, but a plugged vent hole in the gasoline-tank cap sometimes produces mystifying results, because the flow of gasoline is interrupted only partly. Air must be allowed to enter the main gasoline tank to take the place of the supply drawn into the vacuum tank by the suction of the manifold. The simplest way to protect the vent hole in the gasoline-tank cap is to solder a small piece of bent copper pipe over the opening, as shown in Fig. 4.

THE injection of air heavily laden with water vapor into the manifold of a gasoline engine helps to keep down carbon deposits and, according to some motorists, actually gives the motor more power. In Fig 5 is shown a simple way to make a device for feeding water vapor into the cylinder at regular intervals, requiring no attention on the part of the driver.

The glass container is an old mason jar, held in place on a piece of heavy sheet metal bolted to the cylinder head. A defunct ammeter supplied the metal top, which is drilled for the two elbows and the filler cap. The pipe that goes from the vacuum tank to the manifold is cut, and the end of it, which is attached to the vacuum tank, is connected with the elbow that has a pipe extending into the solution. The other elbow is connected with the section of the pipe that goes to the carburetor or manifold. At the bottom of the pipe in the jar is placed a small cork float on the end of a pin.

Each time that air is drawn from the vacuum tank into the manifold to replenish the supply of gasoline in the vacuum tank, the air is made to bubble up through the water in the jar and becomes heavily laden with moisture. The check valve is used to prevent sudden pressure in the engine manifold from forcing water back into the vacuum tank.

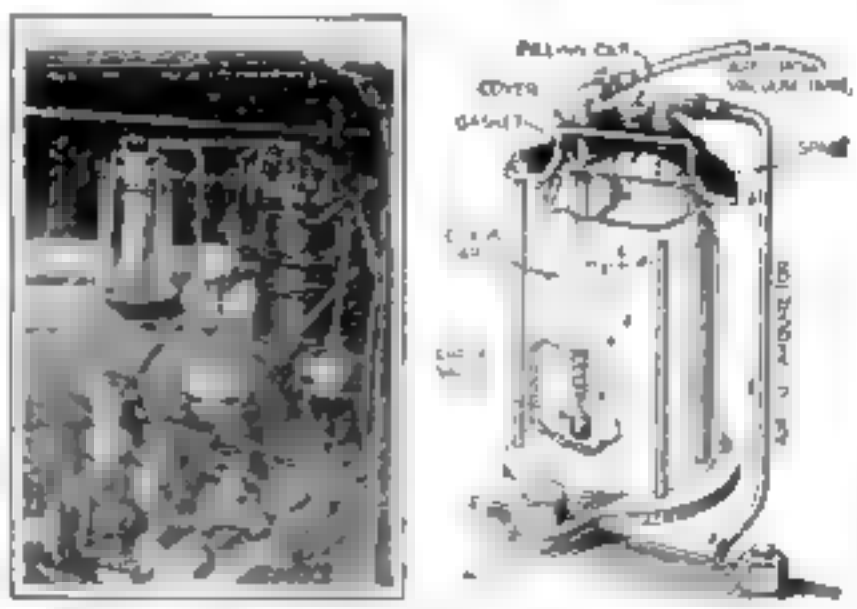


Fig. 5. This simple device for feeding water vapor into the cylinders to cut down carbon deposit works automatically

FIGURE 6 illustrates a simple way to force grease down around the flexible shaft inside the speedometer cable. An old grease-gun fitting was found in the scrap pile that could be screwed into the coupling on the end of the shaft. A hole was drilled and tapped in the end of this fitting to take a pressure grease nipple.

It is a good idea to force light grease or heavy transmission oil into the speedometer cable at least once every 5000 miles and, while you are about it, check up on the meshing of the fiber gear that meshes with the larger metal gear attached to the front wheel. See that the fiber gear is in position, or it will will wear out in short order.

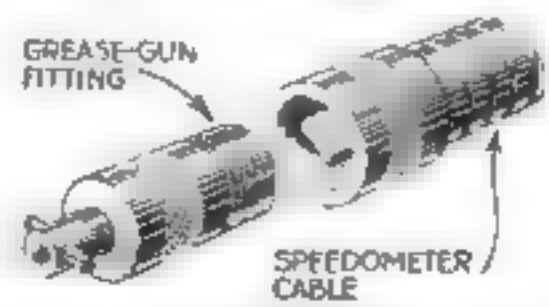
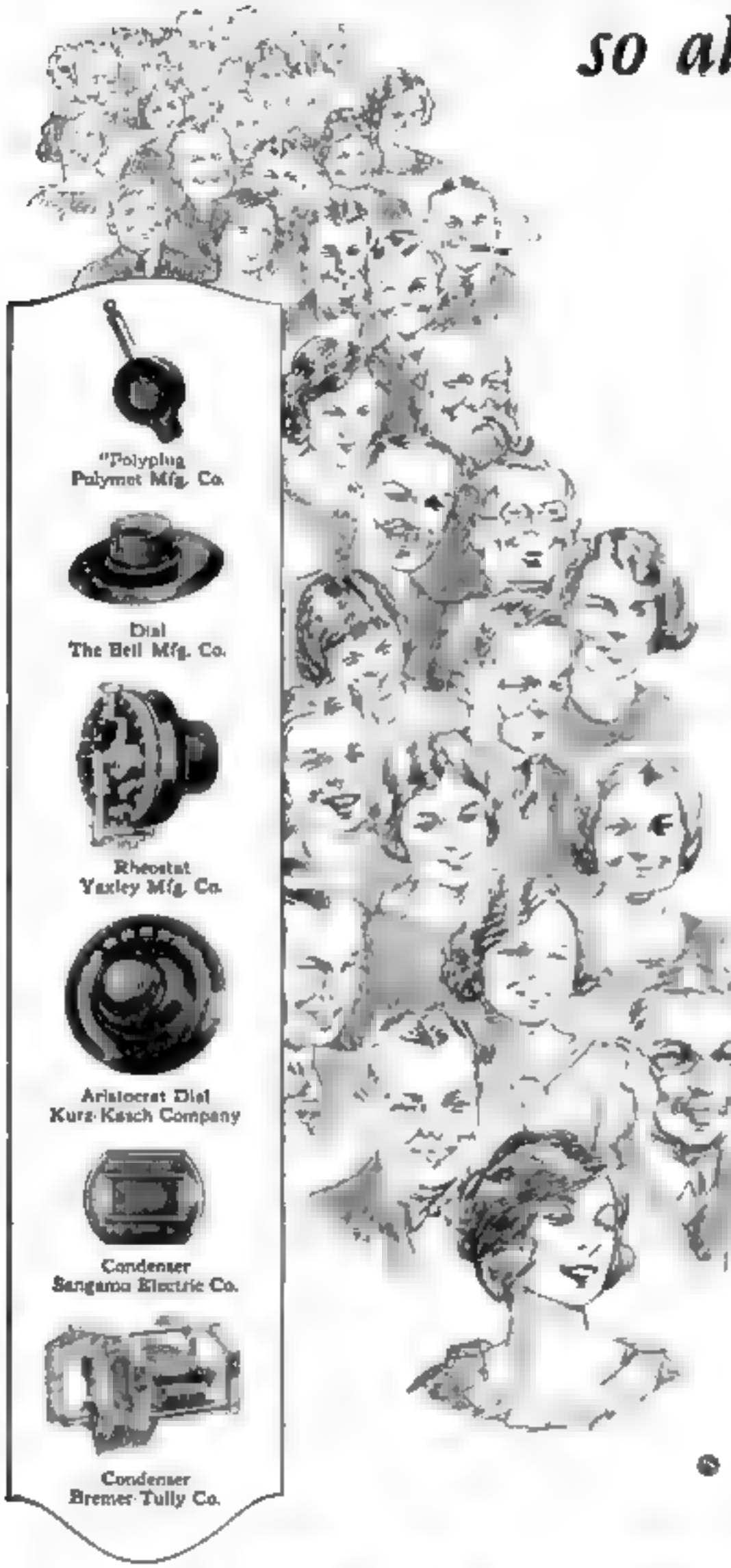


Fig. 6. An old grease-gun fitting screwed to speedometer cable shaft helps lubrication

Radio drafted Bakelite
so all could listen-in



To make available for everyone, everywhere, the marvel of radio reception, radio engineers required an insulating material possessing a unique combination of properties.

Bakelite alone met the need. It combines high insulation value with strength and light weight. It is easily formed into the many shapes required and will not warp, shrink nor swell. It will not absorb moisture and is unaffected by extremes of heat and cold.

All of these properties and the beautiful color and finish of Bakelite are permanent—unaffected by time, use or climate. So "Radio drafted Bakelite," and today it is used by over 95% of radio set and parts manufacturers.

Make sure that the radio set or parts that you buy are Bakelite insulated, for good insulation is essential to clear reception.

Write for Booklet 25

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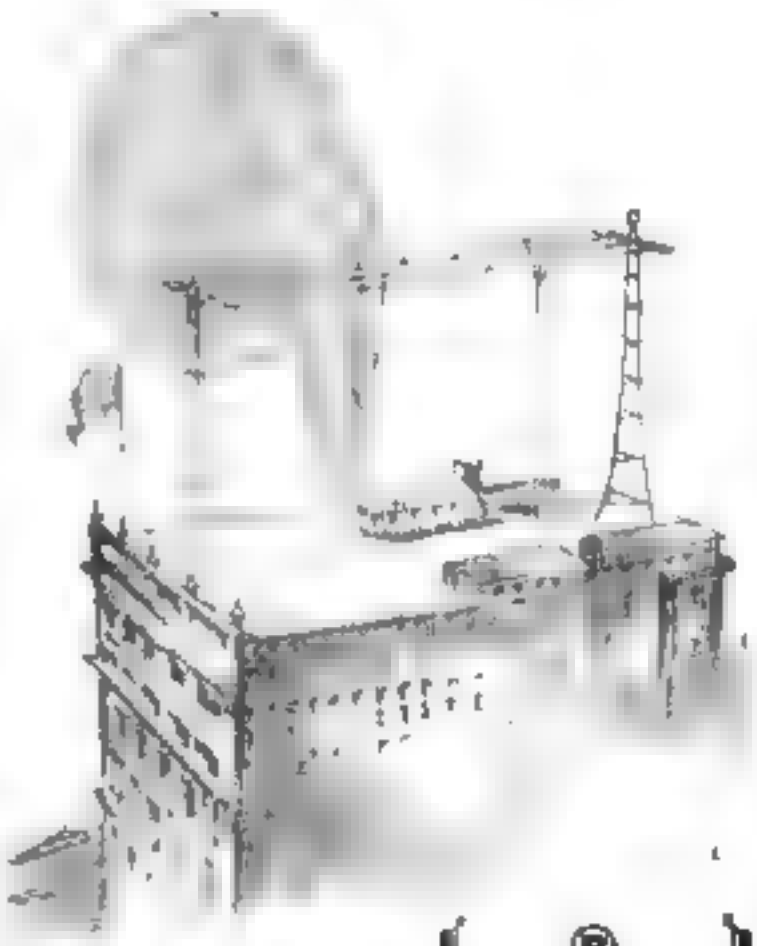

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BAKELITE

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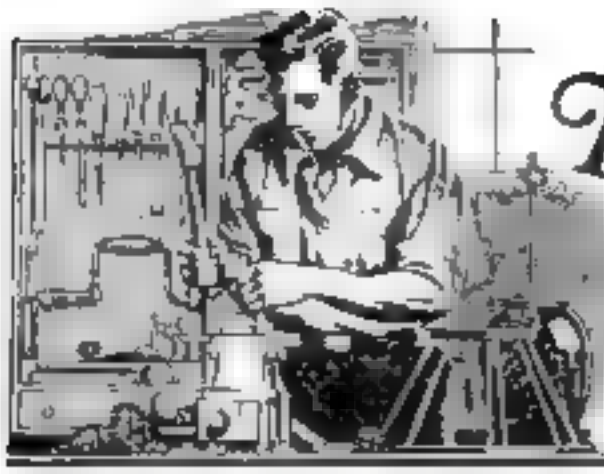
THE MATERIAL OF A THOUSAND USES

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



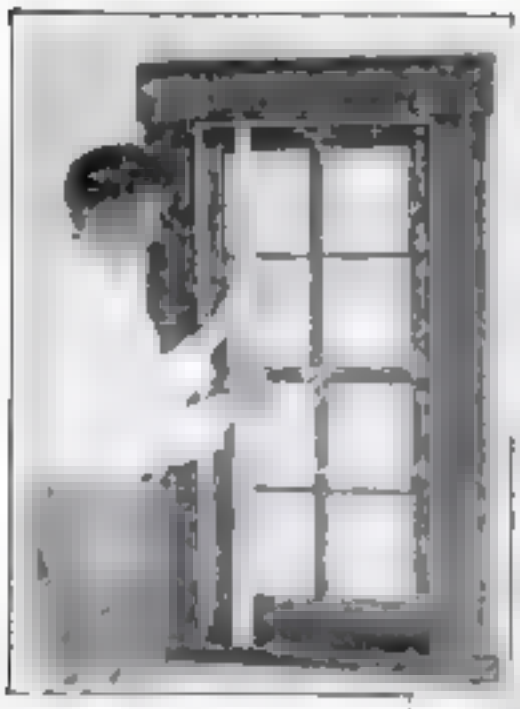
The Home Workshop

Arthur Wakeling, *Editor*

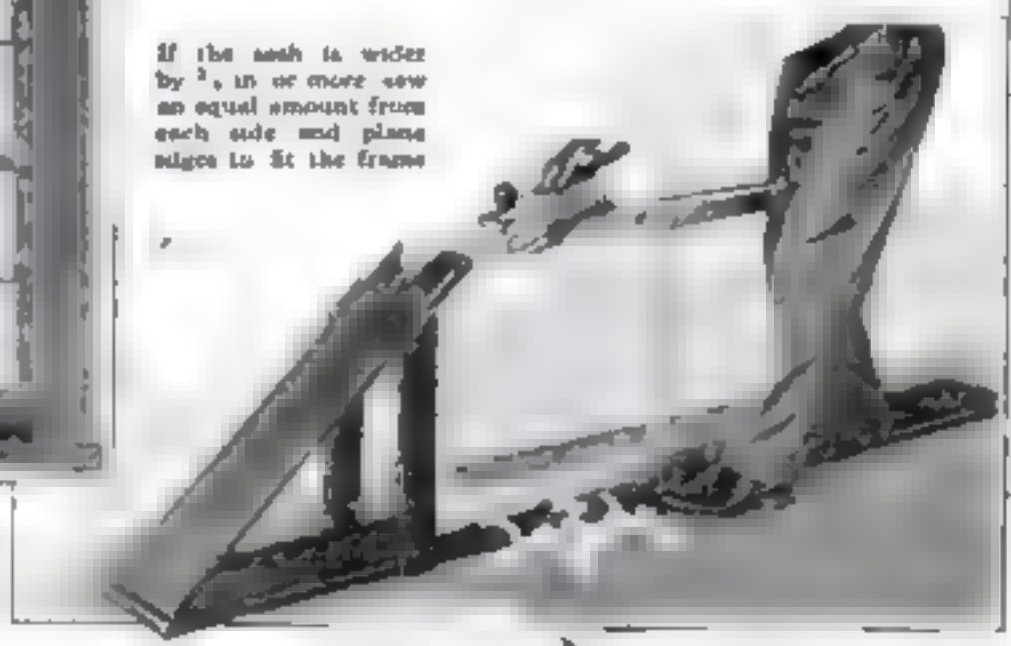
How to Fit and Hang Storm Sash

By F. E. Tustison and Otto P. Schellinger

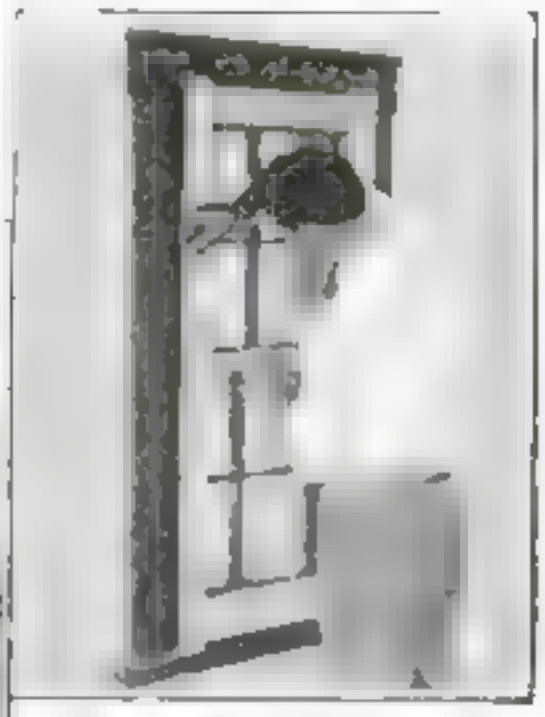
Mr Tustison is Director of Science and Home Mechanics at the Stout Institute, Menomonie, Wis.



Take measurements of the width and length of the window frame and transfer them carefully to the storm sash

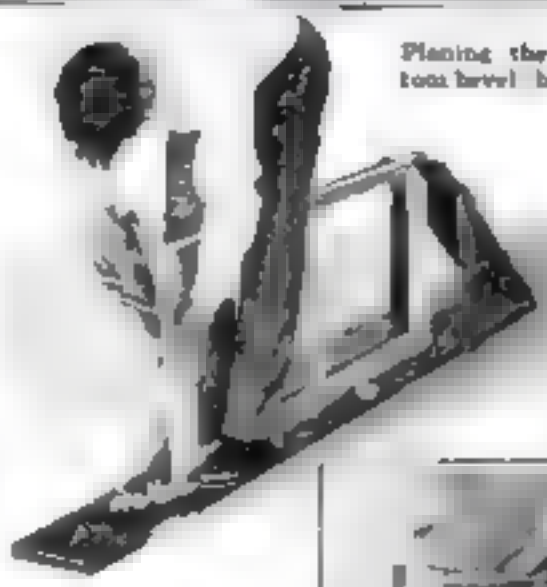


If the sash is wider by ¹⁄₁₆ in. or more saw an equal amount from each side and plane edges to fit the frame

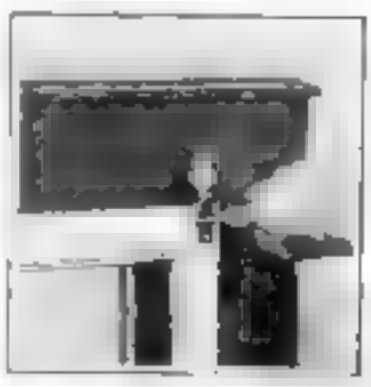


Test each edge by holding the sash in the frame. Mark any high spots and plane them off. Bevel and allow 1/16 in. clearance

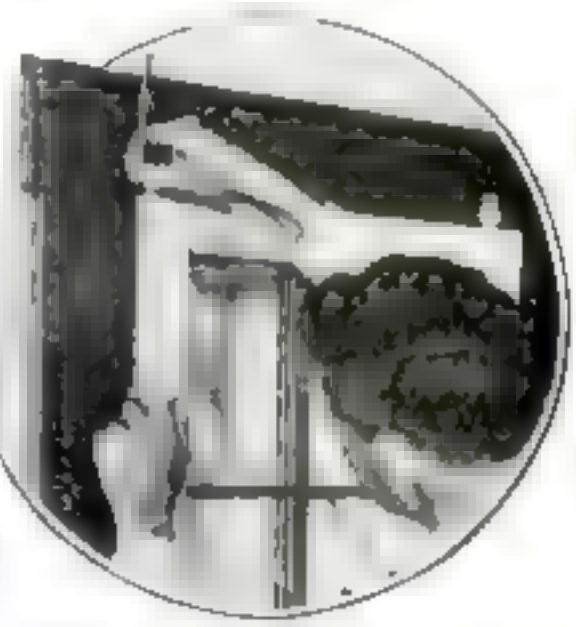
When the sides fit properly stand the sash in the frame and mark the bottom by sliding a block along the sill. Then mark the bevel with the same block



Planing the bottom bevel below)



Fastening one of the hanging eyes to the sash, and the simplest way of numbering the sash by cheeling Roman numerals on edge



Mark the top for length after the side and bottom have been fitted and saw off the waste afterward smoothing down the edge by planing if it is found necessary

PROPERLY installed storm sash are a splendid insulation against wintry blasts. They make it possible to keep a house at a comfortable temperature with less coal. Indeed, the saving in coal, which is now a matter of the most pressing importance to every householder, quickly pays for the double windows.

Usually the extra sash need be applied only on the colder and most exposed sides of the house. The first step is to measure each window frame in the screen rabbet, which is the recess provided at the outside of the frame expressly to take storm sash and outside window screens. Incidentally, the steps to be followed in fitting storm sash are precisely the same as those required in hanging outside screens, and the same hangers serve for both. Prepare a list of the sizes and order the sash from a lumber dealer or mill

Before attempting to fit a sash in a frame, it is well to check the size of the frame and sash. If a number of the windows are the same size, two sticks can be cut, one giving the exact length and beveled at the bottom to suit the slant of the

(Continued on page 112)

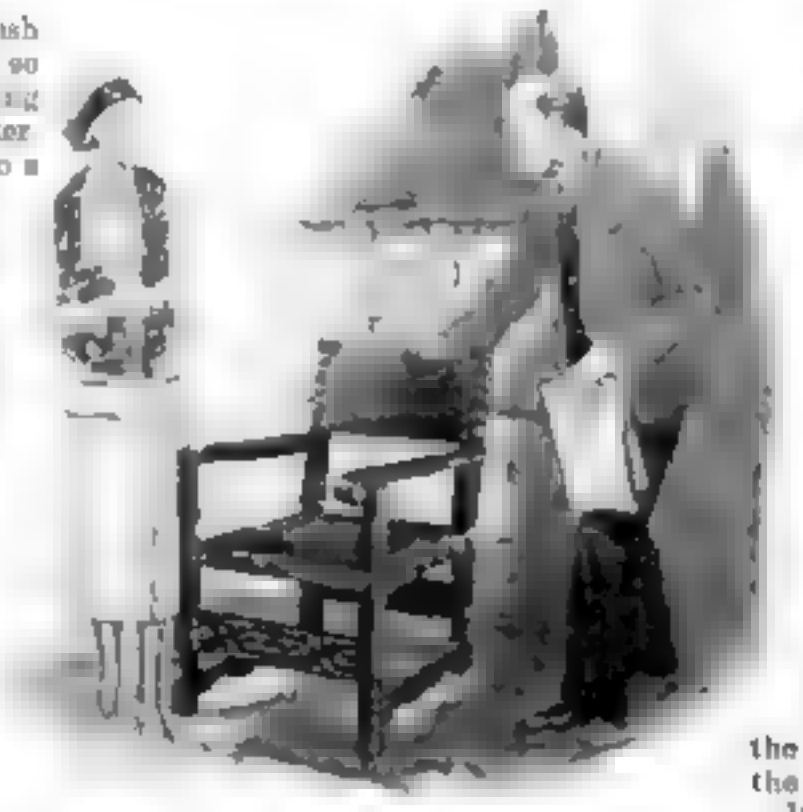
THIS month's Home Workshop will be found on pages 69, 70, and 74 to 124. The Better Shop Methods Department on pages 72 and 125 to 136, and The Shipshape Home, on pages 138, 139.

Chair in the Simplified Spanish Style

A Fine Example of a Type of Furniture Now Very Popular—Its Unique Construction Makes It Unusually Easy for the Amateur to Build

FURNITURE of the so-called Spanish style, which recently has become so popular, holds many fascinating possibilities for the amateur woodworker. Many of the pieces can be simplified to a degree not possible with furniture of other periods and types, yet they are rich, dignified, and exceedingly decorative in appearance.

A striking example of this style of furniture is the chair illustrated. The design is an adaptation of a genuine Spanish chair of great value. The details have been simplified to the last degree by George F. Kaercher, the designer. Practically all the usual difficulties in chair-making have been avoided. Indeed, a chair hardly can be made with simpler joints or fewer angles; in these respects the construction is even easier to follow than the now practically obsolete Mission furniture.



Furthermore, no skill in upholstery is needed, because the back and seat, following the style of the original chair, are simply pieces of Spanish leather fastened to the rails with large brass upholstery nails.

A piece such as this deserves to be made of a fine cabinet wood, and the wood must be hard and strong to insure durability. Oak and walnut are especially suitable.

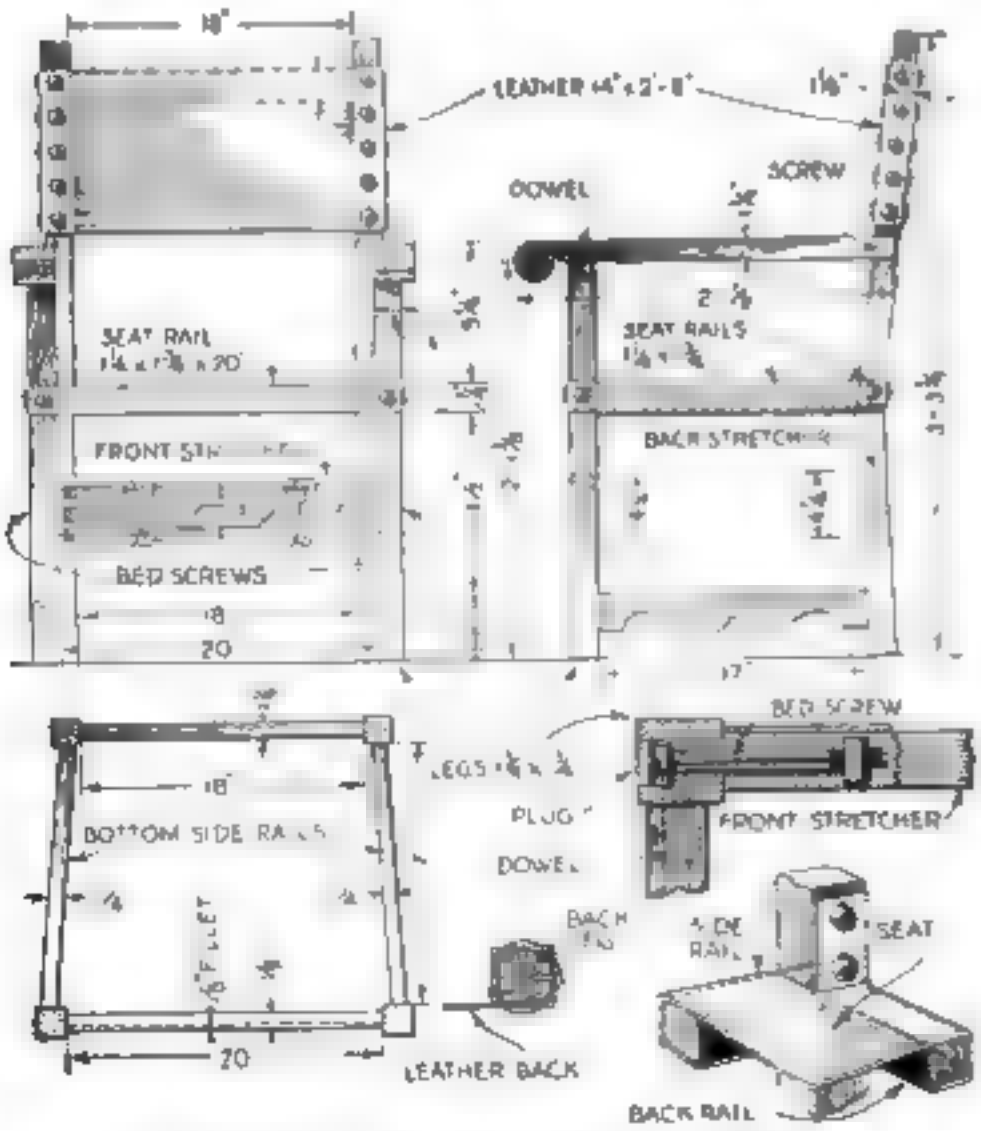
Instead of the usual mortises and tenons, dowels are used throughout in the joints. Great strength is added to the construction, however, by the addition of four bed-screws or bolts, which reinforce the joints between the legs and the front and back stretchers. Each stretcher also has two dowels at each end to keep it from twisting. Slots are cut into the stretchers from the inside faces to allow the insertion of the bed-screw nuts. The 1-in. holes in the sides of the legs to take the heads of the bed-screws are plugged with wood afterward.

To obtain the carved effect on the front stretcher, a piece of wood ½ in. thick is laid out with the design shown in detail below. The waste wood is removed by boring holes and cutting on the lines with a fret-saw. The panel then is glued to the front stretcher. If desired, a few of the smaller fretsawed openings can be pierced right through the stretcher itself. It will be noted that there is only one rail connecting the back legs above the seat level and that is at the upper edge of the leather back.

The leather, which must be of a first class quality and free from imperfections, should be large enough so that the edges can be turned around the legs and rails and nailed very securely. The edges of the rails that are to come in contact with the leather should be rounded.

It is advisable to make a pattern of heavy paper and after it has been cut to fit perfectly, use it as a guide in laying out the leather. It should be noted that the leather is fitted around the legs by making slits; none is removed, as the flaps are made use of and fastened to the legs with upholstery nails, as shown.

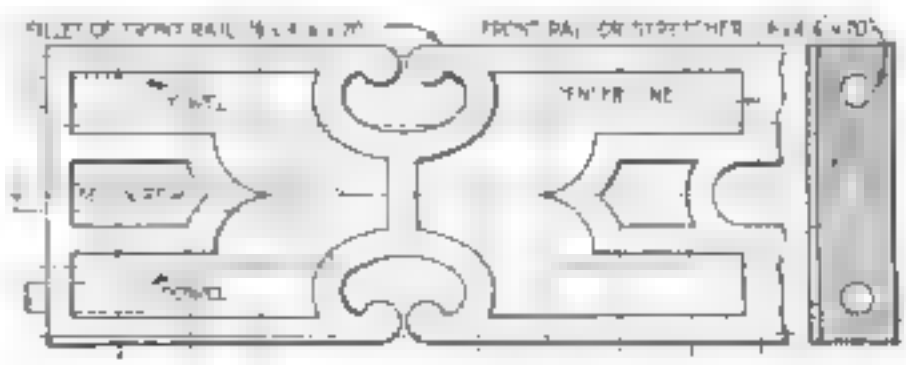
It is possible and in some ways desirable to omit the front seat rail entirely. The seat is a trifle more comfortable without this rail, but the strain on the leather is greater, so that heavy hide must be used.



Front and side views, plan of seat frame, details of bed-screw fastening for stretchers, and method of attaching the leather

Bill of Materials for Spanish Chair

Front legs, 1¾ by 1¾ by 23¼ in., 2 required
Back legs 17½ by 3 by 39½ in., 1 required to cut 2 legs
Front stretcher 3½ by 4¾ by 20 in. 1 required
Back stretcher 1 ¼ by 4¾ by 18 in. 1 required
Back seat rail (doweled) 1¼ by 3½ by 18 in. 1 required
Side seat rails (doweled) 2¾ by ¾ by 17 in. 2 required
Side bottom rails (doweled) 3½ by 7 ¼ by 17 in. 2 required
Front seat rail (if used) ¾ by 3½ by 20 in. 1 required
Top back rail doweled 1¾ by 7 by 18 in. 1 required
Arms (curved in front and grooved in back) 3½ by 2¾ by 24⅝ in. 2 required
Blocks under arms (glued) 1 ¼ by 2¾ by 2½ in., 2 required
Bed-screws (square or screw heads) 7/16 in. in diameter, 6 ¼ in. long, 4 required
Overlay or fillet for front rail (fretsawed) ½ by 4¾ by 20 in., 1 required
Oval-head brass upholstery nails, 1 in. in diameter, 1 in. long, 60 required
Leather for seat, Spanish hide, 27 by 34 in., 1 required
Leather for back, Spanish hide, 14 by 32 in., 1 required
Dowels, maple, 7/16 in. in diameter, 2¾ in. long, 40 required
Tacks, 8 oz., 1 package
Plugs for bed-screw holes, 1 in. in diameter, ¼ in. thick, 4 required
Hard wood to be used, preferably oak or walnut
Stain, filler, shellac and wax



View showing one-half the thin fretsawed piece that is applied to the front stretcher. The light guide lines represent 1-in. squares

Home-Study Business Training —Does It *Pay*?

F. H. LANDWEHR, Sec'y
Electric Auto-Lite Company

The Electric Auto-Lite Company, Toledo

C. O. MINIGER, Pres.
Electric Auto-Lite Company

SIXTEEN members of the Electric Auto-Lite Company are enrolled for home-study training with LaSalle Extension University. LaSalle-trained men and women—in positions of responsibility—are to be found in every large business organization in America.

"It Increased My Income Approximately 700 Per Cent"

—So writes F. H. Landwehr, Secretary of the Electric Auto-Lite Company, Toledo

F. H. Landwehr could still be a clerk in a small pay position—and probably *would* be, if he had not made a certain decision . . .

He did not come to this decision all at once. He will tell you that he practically lost five or six good years.

But when he *did* realize that his future was absolutely in his own hands—that the right kind of home-study business training would quickly speed his progress toward the responsible executive position he aspired to fill—he ACTED.

Today he is Secretary of the great Electric Auto-Lite Company of Toledo. His earnings have doubled—trebled—quadrupled—till today he is making several times as much as he was making as a clerk. Ahead of him lies a splendid future.

And he dates his start toward this greater success from the day when he clipped and mailed a LaSalle coupon.

Send for Salary-Doubling Plan

Have you ever traveled a road when the night was inky black, arrived at a cross-roads, and wondered which way to turn?

In that predicament, have you ever flashed your spot-light on a sign and suddenly seen the name of your destination in big clear letters and a hand pointing out the road which would take you there?

Thousands and thousands of men have arrived at just such a cross-roads in their business experience—have suddenly caught the vision of a successful career in the training offered by LaSalle and have followed that brighter path to the goal of their desires.

For example—during only six months' time as many as 1,248 LaSalle members reported definite salary-increases, as a result of their training, totalling $1,*39*,507, *an average increase per man of 89 per cent.*

What would it be worth to *you* to increase your earnings 89 per cent—within a comparatively few months?

LaSalle offers you a *salary-doubling plan* which has added millions of dollars to the earning power of its members. LaSalle will send you a booklet describing this plan without obligation. Whether you adopt the plan or not, the basic information this booklet will place in your hands is of very real and definite value. And—it's *FREE.*

Balance the two minutes that it takes to fill out the coupon against the rewards of a successful career—then clip and mail the coupon NOW.

LASALLE

"We want men who can think beyond their jobs"

"We want men in our organization today who have the capacity to think beyond their jobs. Highly competitive conditions in industry at this period present more opportunities to the properly trained young man than ever before in history. To my mind, LaSalle Extension University offers an excellent opportunity to the man who wants to get ahead."
(Signed) C. O. MINIGER, Pres.
Electric Auto-Lite Company.

"My training has proved a wonderful investment"

"At the time I enrolled with LaSalle for training in Higher Accountancy, I felt that I could not afford it—but the results obtained have proved it a wonderful investment. I can truthfully say that your training has made it possible for me to increase my income approximately 700 per cent."
(Signed) F. H. LANDWEHR, Sec'y
Electric Auto-Lite Company

LASALLE EXTENSION UNIVERSITY

The World's Largest Business Training Institution

CLIP AND MAIL

LASALLE EXTENSION UNIVERSITY Dept. 1183-R Chicago

I shall be glad to have details of your **salary-doubling plan**, together with complete information regarding the opportunities in the business field I have checked below. Also a copy of "Ten Years' Promotion in One," all without obligation.

- ☐ **Business Management:** Training for official, Managerial, Sales and Departmental Executive positions.
- ☐ **Modern Salesmanship:** Training for position as Sales Executive, Salesman, Sales Coach or Trainer, Sales Promotion Manager, Manufacturer's Agent, Solicitor and all positions in retail, wholesale, or specialty selling.
- ☐ **Higher Accountancy:** Training for position as Auditor, Comptroller, Certified Public Accountant, Cost Accountant, etc.
- ☐ **Expert Bookkeeping:** Training for position as Head Bookkeeper.
- ☐ **C. P. A. Coaching** for Advanced Accountants.
- ☐ **Law:** Training for Bar; LL.B. Degree.
- ☐ **Commercial Law:** Handling, Reference and Consultation Service for Business Men.
- ☐ **Traffic Management**—Foreign and Domestic: Training for position as Railroad or Industrial Traffic Manager, Rate Expert, Freight Solicitor, etc.
- ☐ **Railway Station Management:** Training for position of Station Accountant, Cashier and Agent, Division Agent, etc.
- ☐ **Banking and Finance:** Training for executive positions in Banks and Financial Institutions.
- ☐ **Industrial Management:** Training for positions in Works Management, Production Control, Industrial Engineering, etc.
- ☐ **Modern Foremanship and Production Methods:** Training for positions in Shop Management such as that of Superintendent, General Foreman, Foreman, Sub-Foreman, etc.
- ☐ **Personnel and Employment Management:** Training in the position of Personnel Manager, Industrial Relations Manager, Employment Manager, and positions relating to Employee Service.
- ☐ **Modern Business Correspondence and Practice:** Training for position as Sales or Collection Correspondent, Sales Promotion Manager, Mail Sales Manager, Secretary, etc.
- ☐ **Business English:** Training for Business Correspondents and Copy Writers.
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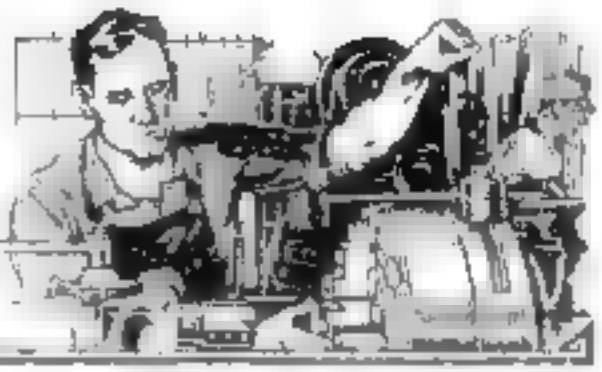
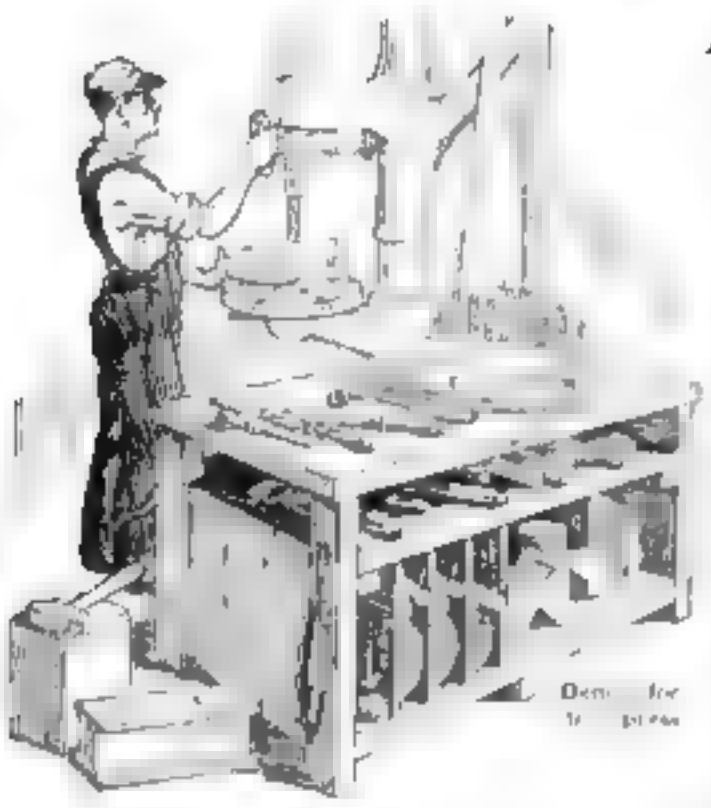
Better Shop Methods

How Expert Mechanics Save Time and Labor



Racks *and* Tables *for the* Shop

How to Keep Lathe, Drill Press, and Planer Tools and Accessories in Shipshape Order



By Henry S. Laraby

"WASN'T the big boss peeved this morning, when he found that the die for that new customer couldn't be delivered?" Jim Bailey remarked with his tantalizing grin, looking at Joe Black, who sat on an empty carbide can behind the shop, making away with his lunch

Black scowled at his tormentor. The other machinists looked on in amusement, they relished the idea of an argument for the 15 minutes that remained of the lunch hour

"Of course he was mad!" Black retorted. "But it was not all my fault. What can he expect when I have to hunt half an hour for a piece of half-inch steel, and then have to plane down a piece from three-quarter stock; and on top of that, when I went to grind it, there was no wheel of the proper grade. With all those things against me, I think I did very well."

"A very good excuse, but as they told me when I was in the army, it is results, and not excuses that are wanted"

A third man entered the discussion. He was of the type who seem always to merit the title "Mister." Older than the others, he was recognized by all in the shop, the foreman included, as being a master workman.

"The shop and its owner have a lot on their shoulders," Mr Jackson said; "but, after all, the company is known by the men it keeps, and it is up to all of us here to help matters along."

"That would not put a piece of half-inch steel in the rack," Black stated with emphasis.

"No, it would not put the steel there, but it would have the bolts and clamps in the places where they are used, and not hidden away in Bailey's drawer."

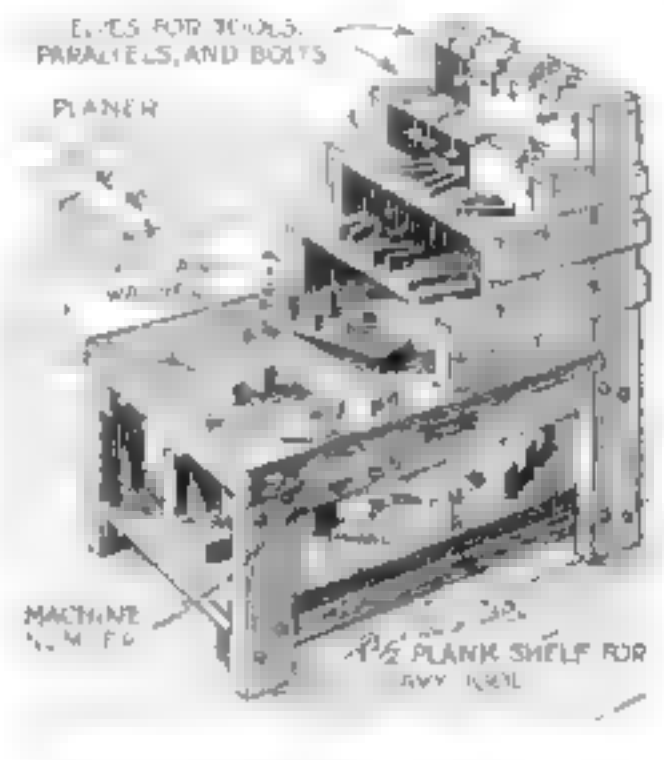
Bailey winced at the thrust

"Now over by the planer is a heavy bench. It has several shelves, some of them with holes and slots in them for bolts, but there are no bolts there. The clamps are gone too. Is the shop to blame for all of that?"

"I guess not," Black replied. "I remember when I first came here that every one seemed to keep things where they belonged."

"And another thing," Mr. Jackson continued, "I am sure that you lost an hour and a half in boring the holes in that die because you could not find a drill chuck that would fit the tailstock spindle of the lathe you were using You finally had to take out your job and true up the center, which some one had broken off and left"

"That reminds me," Bailey said, "of the way they used to keep the tools



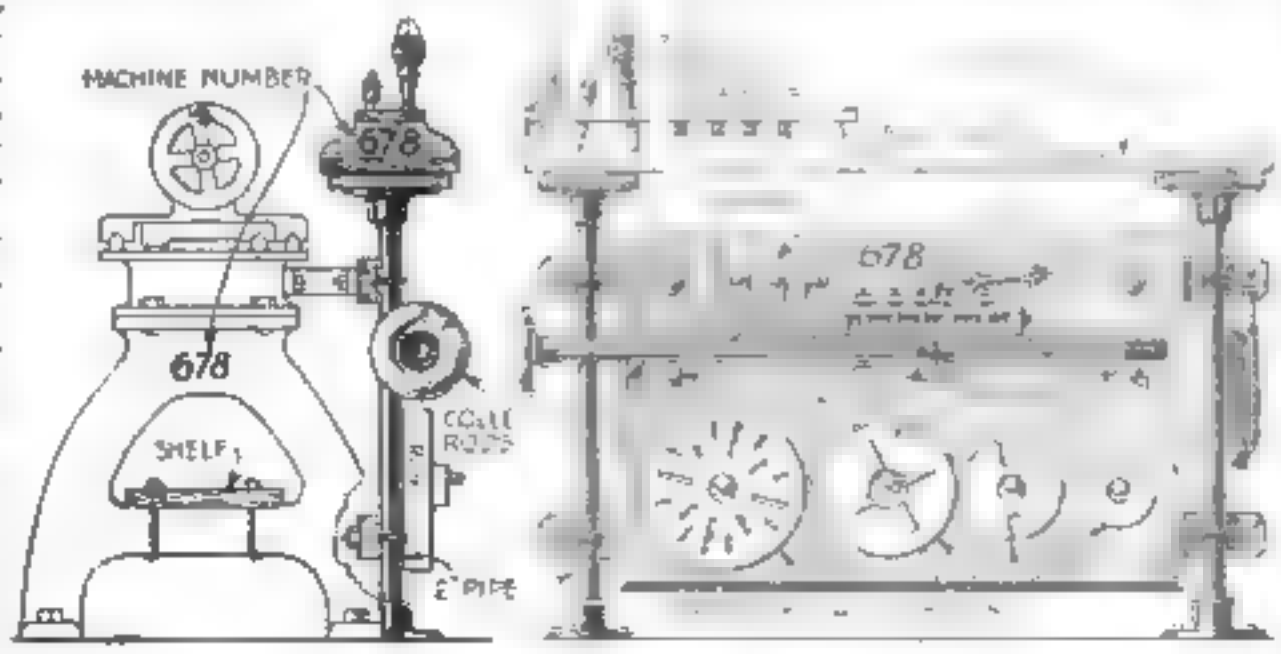
A heavily built and conveniently arranged table for planer tools, straps, parallels, bolts, and nuts

together in a shop where I once worked. At the back of every lathe there was a board, with places for everything that belonged to that lathe. If you used that lathe and did not put everything back on the board, one of the toolmakers would be sure to ask you why you had not, before the foreman had a chance to find out about it."

The shop's foreman stood in the doorway smoking his pipe. He appeared to be an interested listener

"I suppose you boys are raking me over the coals, too," he said. "I told the boss about not having the proper size steel, and not having sufficient grinding wheels, and he has promised to get them. That is one result of this occurence. But there are a lot of things we can do ourselves to make it easier to get out the work.

(Continued on page 130)



Lathe tool rack of wood supported by pipe standards. There are places for the faceplates and chucks, collet rods and collets, straps, bolts, and other accessories

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which is on pages 125 to 136.

The Home Workshop

How to Make Best Use of Glue in Your *Home Workshop*

By Ernest F. Spencer

NOT much in the way of woodwork or house repairs can be done without the aid of glue. For that reason the Editor asked Ernest P Spencer, an authority on glue and the head of the technical service of one of the largest glue manufacturers, to prepare an article telling the best ways to use glue in the home workshop. He responded with the following article, which gives in brief practically all the information you need to know about glue.

A dairy thermometer is used to avoid accidentally heating animal glue beyond 150° F

HAVE you ever had the pleasure of a little workshop in your own home? It may be down in the corner of the basement or tucked away up in the attic, or even in the kitchen. Wherever it is, many beautiful and useful things can be produced in it for your own use or for gifts for yourfriends.

In building and repairing, glues play such an important part that we should know more about these sticky substances and how to use them so that the articles made or mended with their aid will hold together under all reasonable conditions of every-day use

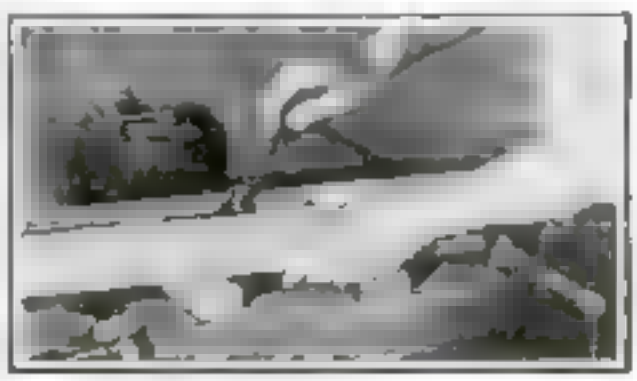
Weighing both the dry glue and the water is necessary to insure the best results

Glue has been used for many centuries. Back in the days of the Egyptian pharaohs it was used to build beautiful veneered work. Through the centuries its uses have been multiplied.

Like the earliest glues, the bulk of those made today are from scraps of the hides, the fleshings, and the bones of animals. They are sold in ground, flake, and sheet forms.

Liquid glue usually is made from fish stock, which is washed and cooked in a similar way to animal stock. A very interesting characteristic of glue made from fish stock is that the gelatine or extracted glue does not jell, but remains in a fluid state at ordinary temperatures.

Cheap liquid glue should be avoided, because it gathers moisture. It contains quantities of salts, such as sodium chloride or common table salt. These salts absorb moisture just as salt on the table will do and on a wet or humid day the glued materials are apt to fall apart.



Hot glue always should be applied freely to both edges of wood to be joined

Good liquid glue has many advantages over other adhesives for use in the home workshop. It is purchased ready for use, so no weighing, soaking, or heating is required. On account of its slow setting quality, the workman is given ample time to get the joints properly together, whereas with hot glue the work must be done quickly before the glue sets or jells. Slow setting also means good penetration of the glue into the wood and added strength. When strength is compared, good liquid glue is as strong as good animal glue.

During the war, glues made from casein were developed rapidly. Casein glues come in dry powder form and are prepared simply by stirring into cold water. They make a strong, moisture-resisting joint. For glued work exposed to outside weather conditions they have no superior. They are used universally in building airplanes.

There are other so-called glues made from starches, dextrines, and blood albumen, which are used commercially for many purposes.

To obtain the best results with glue in the home workshop, we must have certain equipment. This should include a can of the best quality liquid glue, some high grade cabinet flake glue, a jacketed glue-pot, two glue brushes, a cheap dairy thermometer, clamps, and hand screws.

Glue-pots can be purchased at any hardware store at prices from $1 to $2, according to size. The outer vessel is

(Continued on page 113)

Unlike Some Music OZARKA SERVICE Satisfies Every Owner—

IN radio, when one selection does not please, you simply tune it out and pick up another broadcasting station. If it is a matter of unsatisfactory volume or tone in your instrument then it becomes an entirely different matter.

You have certain very definite ideas in mind as to what you want your radio to do. Will you allow us to make a few suggestions regarding a plan whereby you can settle the radio question?

Select the instruments which you think might answer. Have a demonstrating instrument brought to your home. Let each salesman, in turn, make the necessary battery connections. Let him tell you how to operate it but do all the tuning yourself

You'll buy the instrument then, based on your own operation. You'll size up each one for

—ease of tuning
—distance received
—volume
—tone
—selectivity
—price.

There still remains one very important question to settle—the matter of service. No matter what anyone tells you sometimes little things may go wrong. The best radio salesman often knows nothing of correcting radio troubles—satisfy yourself.

Our Ozarka representative in your community will gladly put an Ozarka in your home for such a test. More than this, you will find that he is a thoroughly trained mechanic on our instrument. He has gone through a complete course of study under Ozarka Engineers, the men who designed and perfected the Ozarka.

3187 such men today can correct any trouble which may ever occur on any Ozarka instrument—more men are being factory trained daily. You wouldn't buy an instrument blindly—then don't buy service the same way Any radio instrument is only as satisfactory as the quality of service behind it.

Our Book No. 200 shows the full Ozarka line from $75.00 to $197.50, complete with all accessories.

A Few More Men are Needed

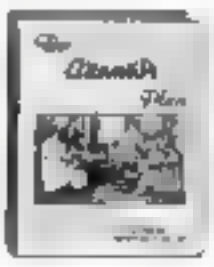
In a great many counties we have the man we want. He is rapidly building up a permanent and profitable business of his own because he has an instrument that will more than meet all competition. More than this, he is trained to back up his sales with the kind of service that counts.

Many well established Ozarka representatives started by giving us only their spare time—their evenings. If your county is open you can do the same.

The investment in cash is very small. The investment in time necessary for study is considerable. It requires patience, but the results have enabled many men to get out of the salary and time clock class.

Any previous sales experience is helpful but not necessary. We can and will teach you how to sell.

Send for 64 Page Book— "The Ozarka Plan"



This book is entirely too expensive to be sent out on postal card requests. It will be sent FREE to any man who mails the coupon below and who is really anxious to improve his condition. Tell us about yourself—ask for Ozarka Plan No. 100 and don't fail to give the name of your county.

OZARKA INCORPORATED

120 Austin Avenue R
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.

Name .....
Address ..... City .....
County ..... State .....

Were this Button

120 Austin Avenue R
Chicago, Illinois

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" No. 100, whereby I can sell your radio instruments.

Name .....
Address ..... City .....
Business ..... State .....

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

The Eyes of an Attic

Simple Dormer Window Construction—Third Article on Reclaiming Waste Space in Your Home

By Edwin M. Love

IF THERE are no attic windows or gables in which windows can be put, a dormer or two must be built to give light to an attic room. That illustrated in Fig. 1, which is suitable for the typical attic room described in this series, is comparatively simple to build. While the window thus obtained is high up from the floor, it serves its purpose very well

Fig. 1. A dormer window the amateur woodworker can build without difficulty. The roof is shown as if partly broken away

Plumb up from the floor plate to get the line of intersection between the side wall and rafters. Decide on the location and width of the dormer (in this case, an 8-ft. gable centered on the room) and drive a nail through the roof at each side of the dormer

Cut out the roof and tear off shingles from this base line to the ridge, "breaking back" in such a way that when the dormer is completed, new shingles may be fitted out to the valley from the old. A careful shingler can keep a line nearly at right angles with the base, as in Fig. 2, page 119, but the amateur may find it necessary, upon reshingling, to tear off more obliquely to get water-tight joints

A jack, pictured in Fig. 3, is a great help in getting around on a roof. It consists of two pieces 1 by 4 or 6 in. and about 12 in. long, with ends cut to fit the pitch of the roof. Thin strips of wood or shingles connect the two to form a seat,

(Continued on page 119)

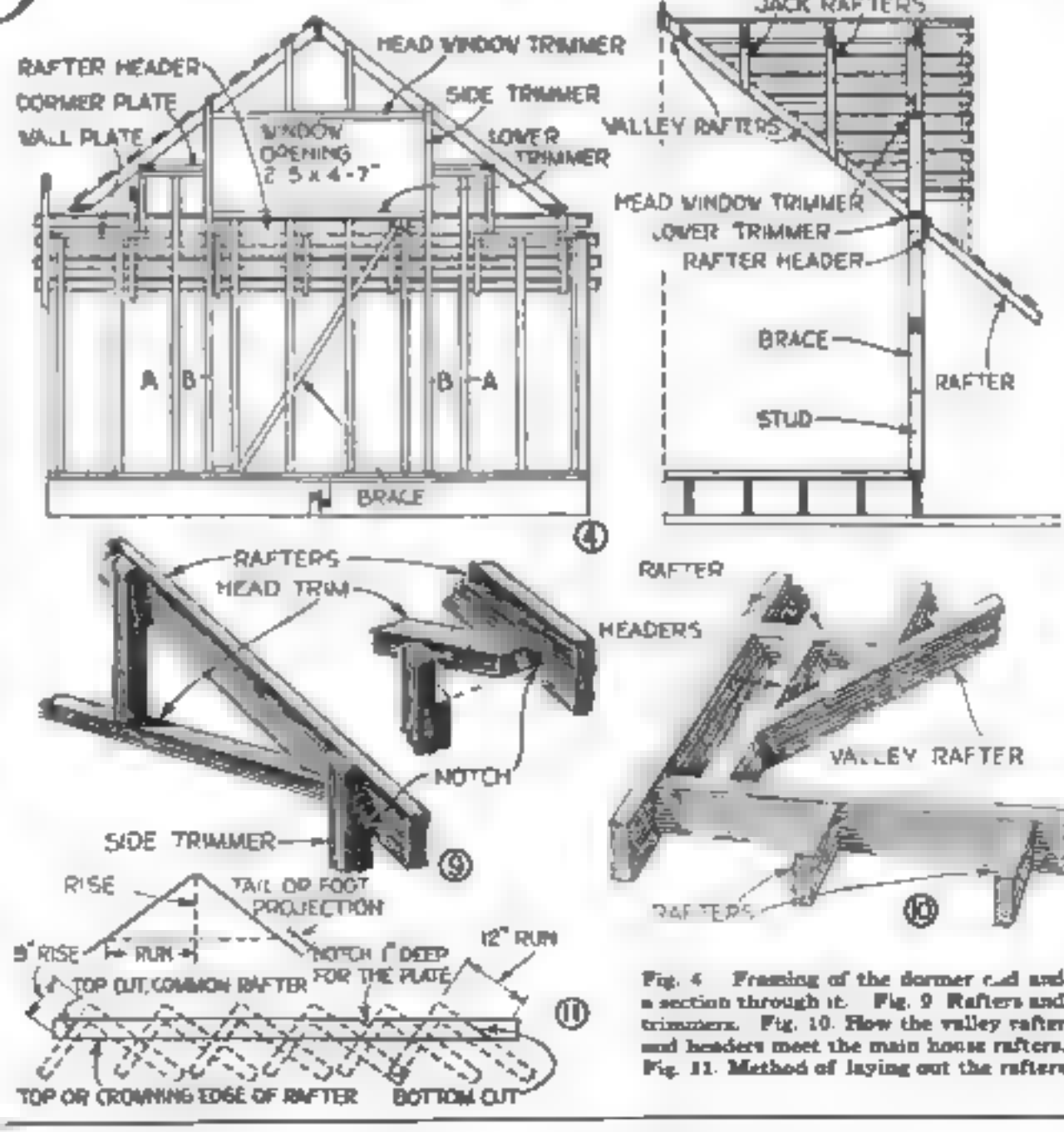
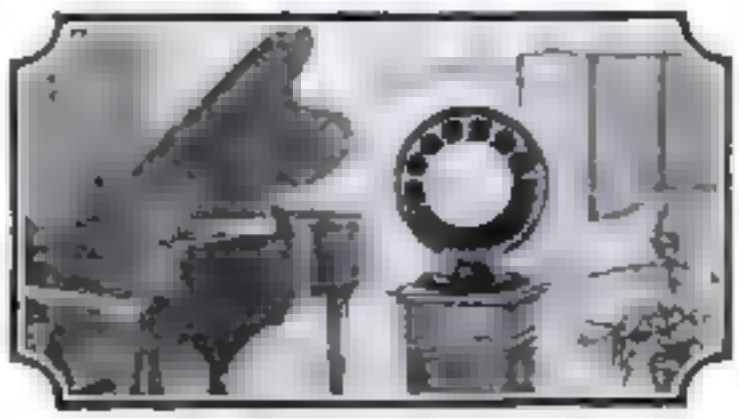


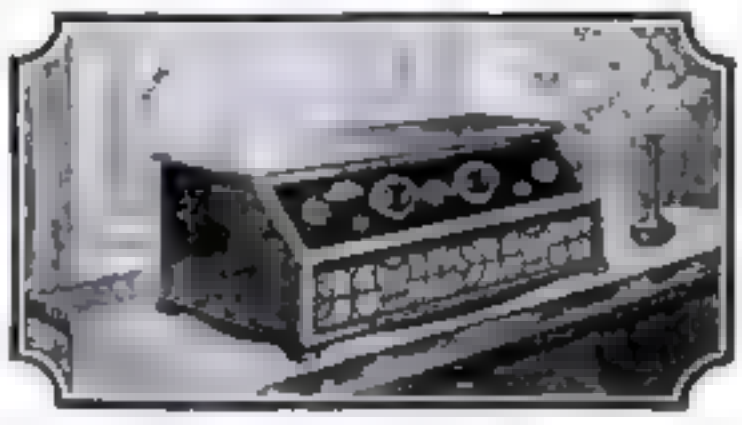
Fig. 4. Framing of the dormer and a section through it. Fig. 9. Rafters and trimmers. Fig. 10. How the valley rafter and headers meet the main house rafters. Fig. 11. Method of laying out the rafters

MUSIC MASTER SUPREME!

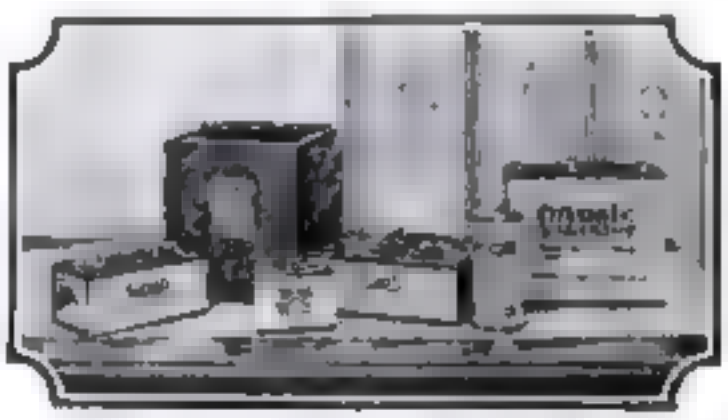
—as in Reproduction, so in Reception



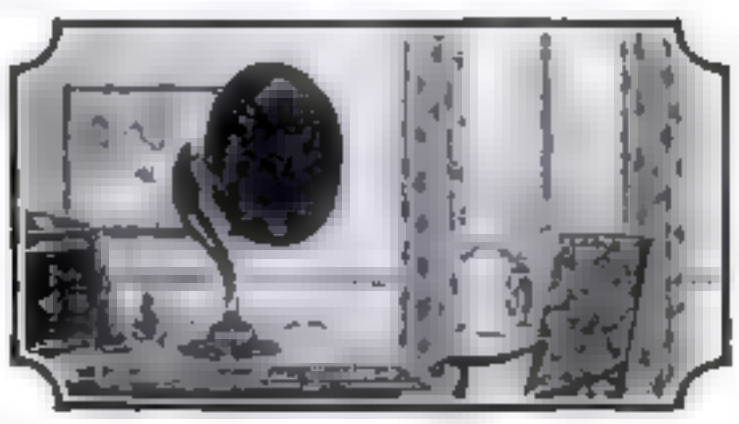
Played, Sung or Spoken before the Microphone—



Music Master's Sensitive Mechanism Receives,



Endues with Power, Clarity and Volume.



Music Master Resonant Wood Insures Natural Tone Quality

BETWEEN broadcasting station and Music Master Reproducer stands Music Master Receiver to bring in today's wonderful New Era superprogram with splendid fidelity of effect and naturalness of tone.

Music Master Radio Receivers incorporate every demonstrated principle of standard radio reception and reproduction.

Music Master Receivers furnish radio reception equal in efficiency to the world-standard quality of radio reproduction achieved in Music Master Reproducer. Perfectly balanced radio reception and reproduction are thus available to discriminating radio lovers.

Ask any authorized dealer to demonstrate for you what clarity in reception may really be—what distance range is really available—what selectivity really means.

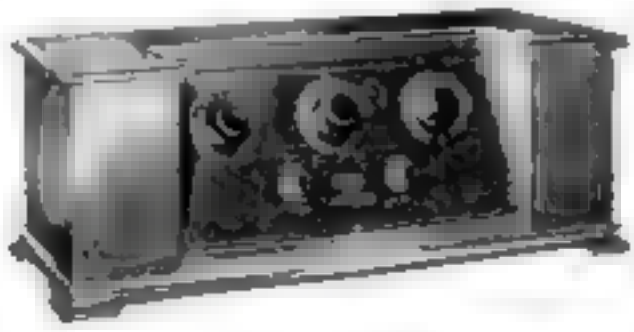
See Music Master—hear—compare—before you buy *any* radio set.

TYPE 60

Five Tubes. Two stages of radio frequency, detector and two stages of audio frequency. Selective, good volume and distance. Brown mahogany art finish cabinet. Price . . $60

(Canadian Prices Slightly Higher)

Ten Models — $50 to $460 — Unconditionally Guaranteed



TYPE 100

Five Tubes. New Music Master circuit, with your special adaptation to radio frequency. Very selective, good volume and distance. Solid mahogany cabinet in brown mahogany art satin finish. Price . . $100

Music Master Corporation

Makers and Distributors of High-Grade Radio Apparatus

CHICAGO NEW YORK **PHILADELPHIA** PITTSBURGH MONTREAL

Canadian Factory: Kitchener, Ontario

Music Master RADIO PRODUCTS

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Steps in Cutting a Dado

A Useful Joint for Door and Window Frames, Shelving, and Furniture

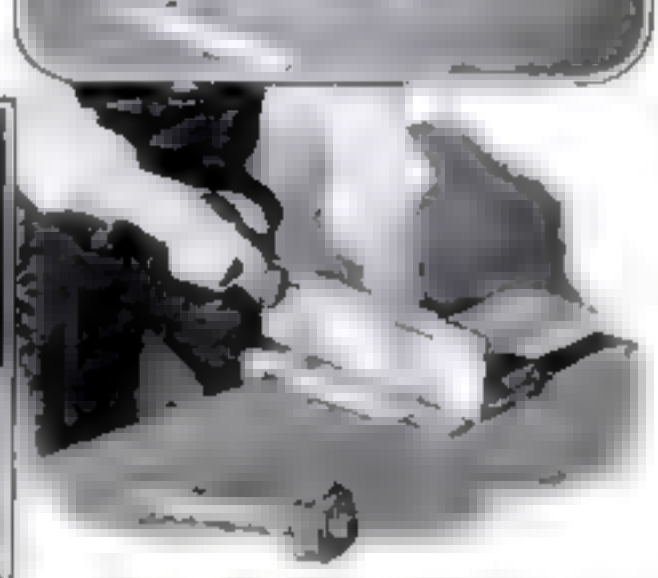
By Emanuel E. Ericson

Noted Manual-Training Authority

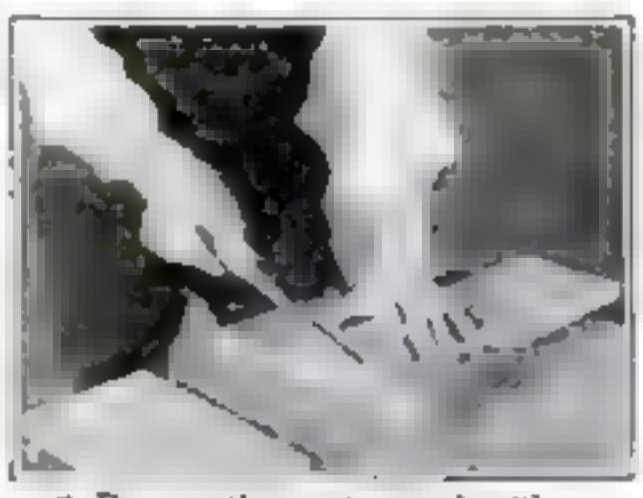
1 After the boards are planed to dimensions, square a knife line across one of them at a distance from the end equal to the thickness of the stock plus the desired extension. This line marks the inner cut for the dado

2 (Below) Place the second board on the first one, mark the width of the stock and square a second line across. Then carefully mark the depth of the dado with a gage

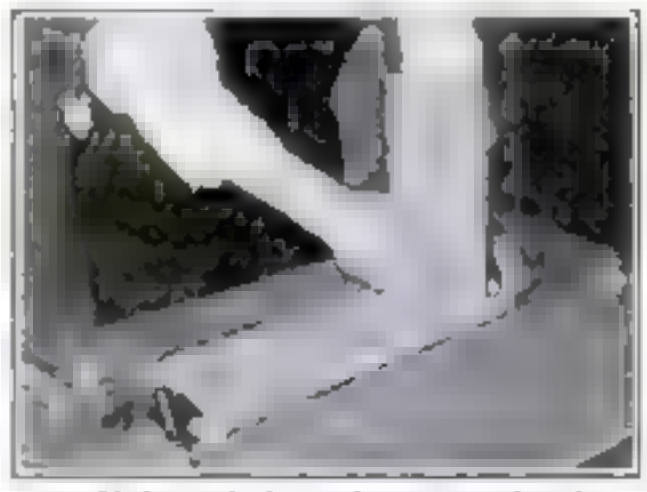
3 Unless you are an expert with the saw, it is advisable first to make a V-groove for starting the saw. That insures a clean and very accurate cut



4 Use a backsaw or any fine handsaw. Start the cut on the farther side and gradually lower the saw to a horizontal position. Cut exactly to the depth of the gage lines on both edges



5 Remove the waste wood with as wide a chisel as possible, working first with the bevel down and then with the bevel up. Test it with a square



6 If the dado is made accurately, the parts should fit without play when pressed firmly together. The joint may be fastened with glue or nails, or both

Making a cross-lap joint will be the next wood working operation to be illustrated pictorially in this series by Mr. Ericson in the December issue

The Home Workshop

Trunk Carrier for a Ford

By H. D. Smith

ADDING a trunk at the rear of the chassis of our Ford sedan gives it some resemblance to the sport model of a more expensive car. It also provides a convenient place in which to carry blankets and tools—a storage place that is readily accessible without disturbing those who are riding on the rear seat of the car.

To attach a trunk of this type securely to a Ford car is no easy task. The original tire carrier gives a more secure contact with the frame of the car than anything that could be made easily. By cutting four rivets within the "tire circle" of the carrier, the circle may be removed. The supports then are sawed off 10 in. from the frame in such a way that they can be bent toward each other to obtain two vertical surfaces. To these tire-carrier supports the front of the trunk supports are to be fastened.

Trunk attached to a Ford sedan

Next, two bar irons ¾ by 1¾ by 21 in. are bent at a right angle at one end. The bend is 1 in. from the end and a ⅝-in. hole is drilled between this bend and the short end of the bar to allow each piece to be bolted to a tire support. One inch from the other end and at two other places planned to come under the trunk, other holes are drilled. These irons then are bolted by their short ends to the lower hole in each of the original tire carriers.

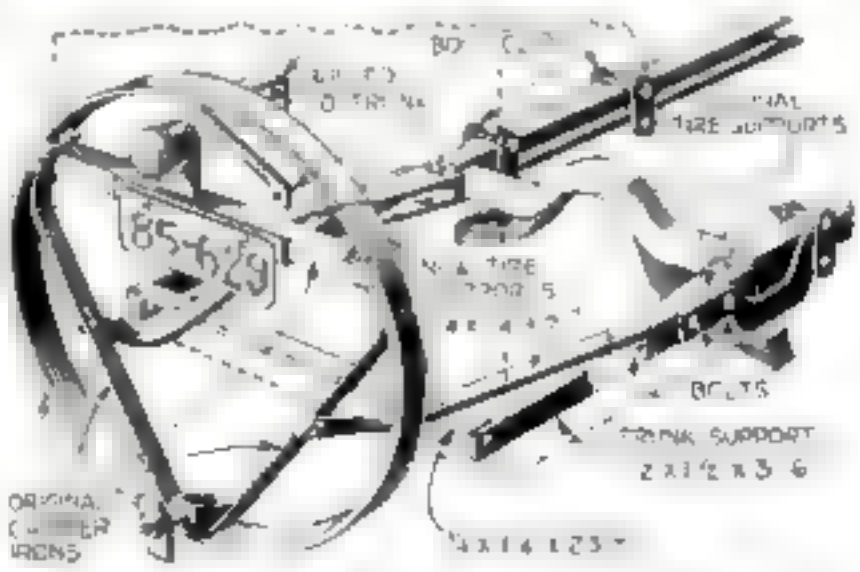
Another iron bar of the same size is shaped into a broad U, bent at right angles at 1 in. from each end. The center part is long enough to extend from one auxiliary support, described in the next paragraph, to the other, or a distance of 21½ in. This iron is drilled so that it can be bolted to the L-shaped pieces under the trunk and to the auxiliary supports at each end.

Two reinforcing irons or auxiliary supports are hammered by a blacksmith from a ½ by 1½ in. bar of steel, 42 in. long. To make them fit on the frame under the car and also run past the old tire-carrier supports to the new cross piece, they have to be bent down about 2 in. and then back to a straight line on their top edge. They are bolted to the U-shaped piece and to the original tire carriers as shown, and then strapped to the frame, of the car, each with two U-shaped clamps.

In order to fasten the tire carrier to the back of the trunk, another brace, shaped like a triangle, is made and fastened with two bolts to the trunk. The tire circle then is bolted to this bracket at the top and to the two irons extending from under the bottom. An extra length of wire was found necessary to connect the tail-light in the new position.

The trunk is covered with auto-top material and the corners are trimmed with sheet zinc 2 in. wide, bent in the form of an angle iron.

The carrier on our Ford has been in use since a year ago last August. As we used the car about town all winter long, we feel that it has proved itself a permanent fixture.



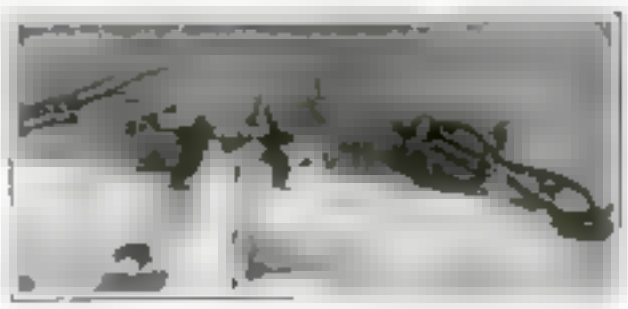
Only six pieces of bar iron and steel and four clamps are needed to construct this durable trunk carrier for a Ford car

—

INLAID linoleum makes an excellent top for the kitchen work table. Cut a piece the size of the table top and fasten with glue. A coat of varnish improves the wearing qualities.

Toy Used as Pattern for Paper-Weight

BY USING a baby's toy for a pattern, an ornamental lead or brass paper-weight can be cast quite easily in any shop where there are the necessary facilities. Before assembling the flask, the impression in the cope is filled in partly so as to cut off the two lower legs and give a flat bottom surface. The two upper legs are especially handy for holding a magazine or book open at a certain page, as illustrated.—HAROLD E. BENSON.



A novel paper-weight, especially useful for holding open magazines and shop reference books

NO-DIAL 5 Tube Receiver $98.00 less accessories

~and Now a Receiver Without Dials! Simple, trouble-proof, beautiful- New!

10% ADDITIONAL WEST OF THE ROCKY MOUNTAINS

NO-DIAL is a new combination of tuned radio frequency and resistance coupling.

Simplicity of operation is amazing. NO-DIAL brings in near and distant stations by the mere rotation of its cover!

Permanent Visable Station Record

The cylindrical NO-DIAL case is of spun aluminum, absolutely shielding it from body capacity. Finished in brown mahogany crystalline, matching the higher priced loud speakers.

Tube for tube the NO-DIAL recognizes no superior and on test it has outperformed many higher priced sets. If your dealer can't supply you write us direct and send his name and address.

GUARANTEED

The NO-DIAL is guaranteed against defects in workmanship and material.

NO-DIAL is licensed under Blackmore patents and patents pending. Hogan Patent 1,014,002.

The Ohio Stamping and Engineering Company

Dayton, Ohio, U. S. A.

Listen! Sweetly, clear, an overture—the prelude to a concert in a distant city floats into the room and fills it. A touch of the finger brings it to you. No need to know about radio—no need to understand its myriad technical terms.

Modern Magic! An inventor's dream come true for you. A wonderful instrument is the NO-DIAL, so simplified, so devoid of the possibilities of trouble that one could literally operate it with ease if blind. Here there are no dials to twist—none of the trying nervous tension that the adjustment of dials produces—just pure enjoyment. Be you ever so much of a novice, what you must do for yourself with other radio sets the NO-DIAL does for you. The set for every member of the family.

Scrap the log book—forget past radio disappointments. NO-DIAL is the griefless, worryless receiver you have been waiting for.

Place your order now with your dealer if you expect to get delivery. The demand is exceeding all expectations. Accept no complicated substitute.

Use the coupon if your dealer cannot show you NO-DIAL.

Mail Today
Dept. P. S. 11
THE OHIO STAMPING & ENGINEERING CO.
Dayton, Ohio

GENTLEMEN:

I am a (Distributor)

(Dealer) (Agent) (User)

Without obligation on my part send me full details of NO-DIAL Receivers.

Name .....

Street and Number .....

City .....

State .....

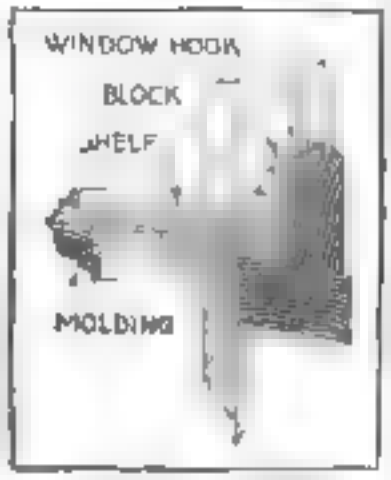
This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Self-Supporting Window Shelf

ODD lengths of molding and a board 6½ in. wide are what are needed to construct the ornamental, self-supporting window shelf illustrated

It can be as long as desired, but it should be cut out at the back to fit neatly between the window stops. The shelf is held in place by the simple expedient of inserting a wedge between it and a common, hooklike metal lift on the lower rail of the window. If there is no lift on the window, a handle of this kind can be purchased at any hardware store and screwed on. Should the window slide very easily, it is necessary to keep it locked while the shelf is in use.



This neat window shelf for holding potted flowers requires no brackets or other unsightly supports

Almost any molding that is on hand can be utilized for decorating the edges of the shelf.—JOHN J. BRINKOS.

Unique Letter-Rack Grips Papers Tightly

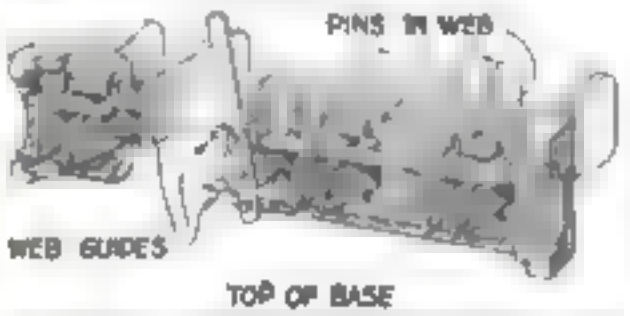
By J. A. Perez

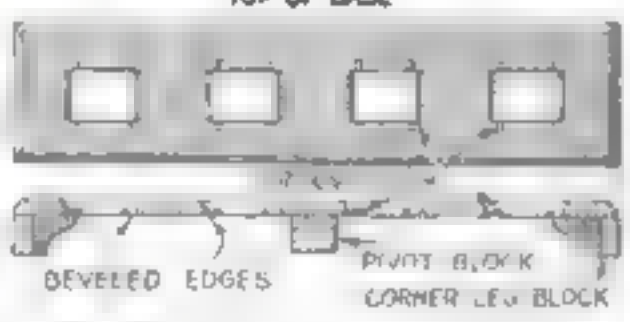
MOVING a lever causes this unique letter rack to close and hold securely any envelopes and papers placed between the four pairs of paper-holders

Moving a lever causes the four paper holders to open or close simultaneously

The device can be made in any size desired. The base, the edges of which may be molded or beveled, is mortised with four openings, as shown. The eight webs then are made and two small nails are driven into the edges of each to serve as the pivot pins.

The web guides then are arranged as illustrated, and each is fastened to every other web so that moving the lever one way will bring the top edges of each pair of webs together; moving it the other way, of course, opens the webs. In this instance, all the parts were made of birch, but any hard wood may be used. The lever and web guides could be made of brass.—J. A. PEREZ.



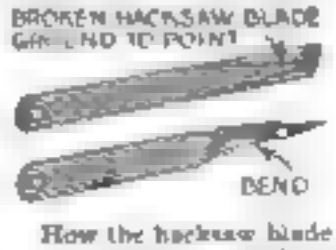


Two views of the base and details showing how the webs are shaped and fastened

Milk-Bottle Cap-Opener Made from Hacksaw

WHEN the point of our milk-bottle cap-opener broke recently my wife resorted to the familiar "thumb" method, with the not uncommon result a shower of milk. I went into the workshop for five minutes and returned with an opener that is much stronger and sharper than the usual commercial type. It is of a type any one can make at no expense.

A worn-out hacksaw blade is snapped off in the vise to give a piece about 4 in. long. The teeth are filed or ground down and the end is filed to a point. The blade then is heated at the point marked "bend" in the flame of an alcohol lamp or gas stove and bent by means of pliers and vise. After that it is heated red and quickly dipped in water to reharden the point. The extreme point is sharpened on a grindstone or oilstone.



How the hacksaw blade is pointed and bent

The heating and bending process may be left out, but the opener works better if bent.—ERIC B. ROBERTS.

Our Family Tree was a Tobacco Plant

No. 1
of a series of talks on
Sweet Caporal Cigarettes
By

Irvin S. Cobb

I THINK there must be a whiff of tobacco in my blood. Fact is, I'm sure of it. My great-grandfather, a Vermont Irishman, went South in a wagon after the Revolution and he raised the first tobacco that was raised for export in what is now called The Black Patch of West Kentucky and West Tennessee. Wise old Yank, he cured and

treated the heavy dark weed after crude processes of his own devising, loaded it on keelboats, floated it down the Cumberland to the Ohio, down the Ohio to the Mississippi and down the Mississippi to the Gulf, where he trans-shipped to sailing vessels and sent his cargoes out to the Gold Coast of Africa to be bartered off for ivory and gold dust. I understand that, dealing with black tribesmen, he rarely got the worst of a deal. For if he was an Irishman, he also was a New Englander. He laid the nills for a substantial fortune.

His son, my grandfather, was a planter, a factor, a re-handler of tobacco; and on the side a merchant and a banker and a steam-boatman. His small fleet of stern-wheelers, manned by crews of his slaves and mostly captained by his own kinsmen, carried tobacco of his growing and his neighbors' growing to the city markets of the Southwest.

For his day he was a rich man until the Civil War came along and smashed him up. For he had bought Confederate bonds and had financed a battery of Confederate artillery

His son, my father, followed in the footsteps of his people. He was a warehouseman. Later he was a buyer for foreign governments and for domestic contractors too. He was accounted one of the best judges of types and grades in the district. He smoked incessantly and he chewed frequently

His son, meaning me, grew up with the smell of tobacco leaf in his young nose, with the jargon of its business in his ears. We lived on a tobacco street in a tobacco town. There was a stemmery on the corner above us, a snuff factory and a cigar-maker's shop down the road and a whole row of warehouses farther along. In the season, the fat hogsheads blocked the narrow sidewalks. I absorbed the romance of the industry for it is one of the most romantic of industries—along with my hot biscuits and New Orleans molasses In four generations, I was the first of the first-born males of my breed to stray from the ancestral pathway.

And now, in a way of speaking, I'm back again in the family line. I have taken on the job of doing a series of signed advertisements of which this is the introductory one. I have declined propositions to turn out advertisements for various manufactured products because I feel I merely would be a hired hand, exploiting this, that or the other thing for so much a word But I reached for this opportunity. I knew I could put my heart in it—could with sincerity endorse the article I was praising.

From time to time in this space, I'm going to write about Sweet Caporal Cigarettes. The first cigarette I ever smoked was a Sweet Caporal. That must be all of thirty-five years ago. Even that far back Sweet Caporals had been on the market a good long while Commercially speaking, the Sweet Caporal Cigarette was born in November 1878

roughly forty-seven years ago. Any product—cigarette or

what you please—which stands the tests of time and competition and shifting popular taste for nearly half a century and holds its own and steadily grows in favor is bound to have merits. It just naturally has to have 'em. It shall be my task to try to explain a few facts about these merits.

Thank you.

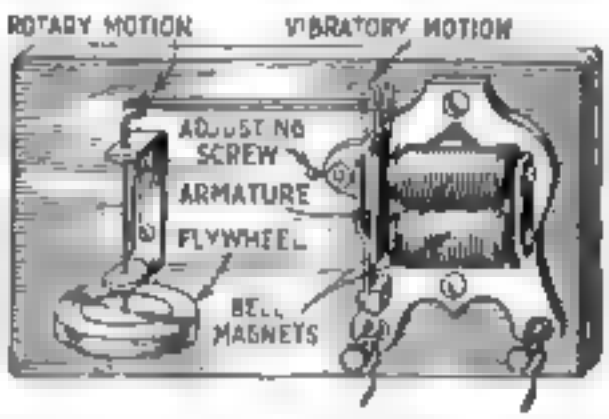
Irvin S. Cobb

P.S. *I operate one of these articles every time in a while. Watch for the next.*

High-Speed Toy Electric Motor Made from Ordinary Bell

A HIGH-SPEED electric engine may be constructed very easily from an ordinary electric alarm bell. The projecting cast-iron gong support is sawed off and the striker arm also is cut off about ½ in beyond the end of the armature. A strip of brass 1/16 in. thick and ¾ in. wide, of suitable length, is drilled at one end to receive the wire striker arm and at the other end to fit the crank on the flywheel shaft. This shaft is No. 14 hare copper wire. At one end it has a crank bent to have a throw equal to that of the armature stroke

Any wheel of suitable size and weight is fastened to the end of the shaft to serve as



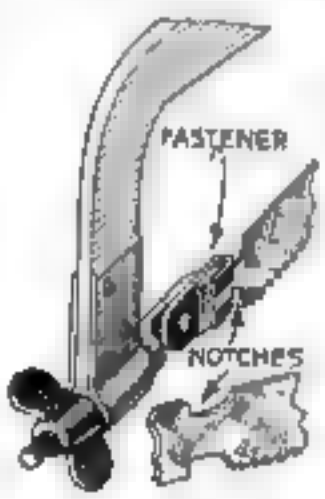
A connecting rod transmits the back-and-forth movement of the armature to a crank shaft

the flywheel. The bearings are simply holes drilled in a U-shaped piece of 1/16-in. brass strap. Two wire rings are soldered to the shaft to keep it in place

The projecting end of the wire striker arm is bent over to keep the connecting-rod strip in place. A wire ring is soldered to the crank just above the connecting strip to keep it from slipping up

When the adjusting screw is properly adjusted and the terminals of the bell are connected with a battery or transformer, the engine will run very rapidly.—W. E.

Salvaging a Short Hacksaw



NO MATTER how careful one is to keep a supply of hacksaw blades on hand, there are times when the last blade breaks. If one piece of the broken blade is fairly long, it can be refastened in the frame with the aid of a fastener bent from sheet iron, brass, or even heavy galvanized iron, as shown. This also can be used for holding new blades that are too short for the frame with which they are to be used.—A. L.

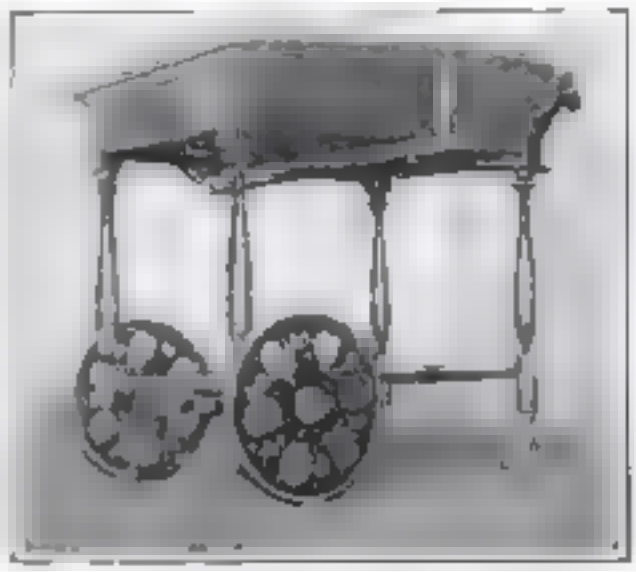
As I use a good bit of mucilage, it occurred to me that the gum oozing out of cherry trees in our yard might be useful. I found it an excellent substitute for gum arabic. It is dissolved in water and in hot weather a small amount of alcohol is added as a preservative.—HENRY BISHOP

The Home Workshop

Automatic Leaf-Raiser for Tea Wagon or Table

By H. Caldwell

EITHER a homemade or a commercial tea wagon or table with small drop leaves may be fitted quite easily with an automatic leaf-raiser. By throwing a lever at one end of the tea wagon or



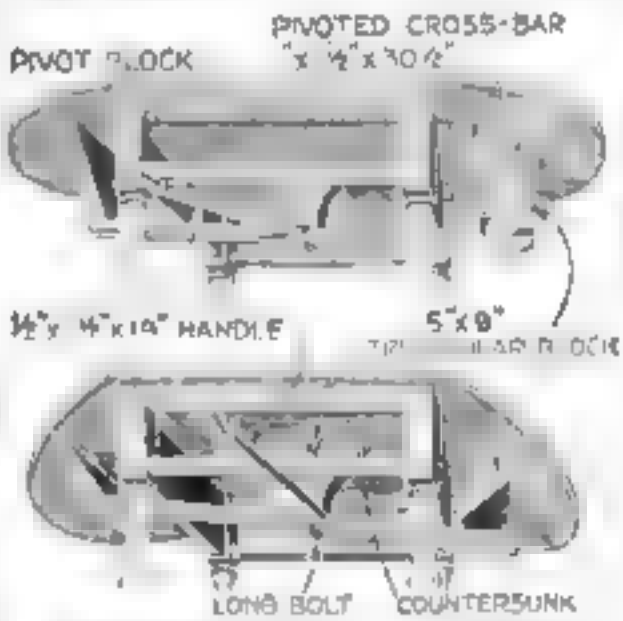
Both the leaves of the tea wagon are raised simultaneously by moving a lever at the back

table, both leaves are raised to the level of the top and held firmly.

The dimensions of the various parts depend upon the size and construction of the tea wagon or table. Hard wood should be used. The stock required for the leaf-raiser illustrated was as indicated in the drawing. The width of the center and side blocks must be the same as the distance between the under side of the top and the bottom of the side rails.

A hole is bored through the center of the pivot block to take a long bolt. The block then is screwed to the under side of the top in the center.

The handle is let into the upper surface of the cross-bar at the center and is at

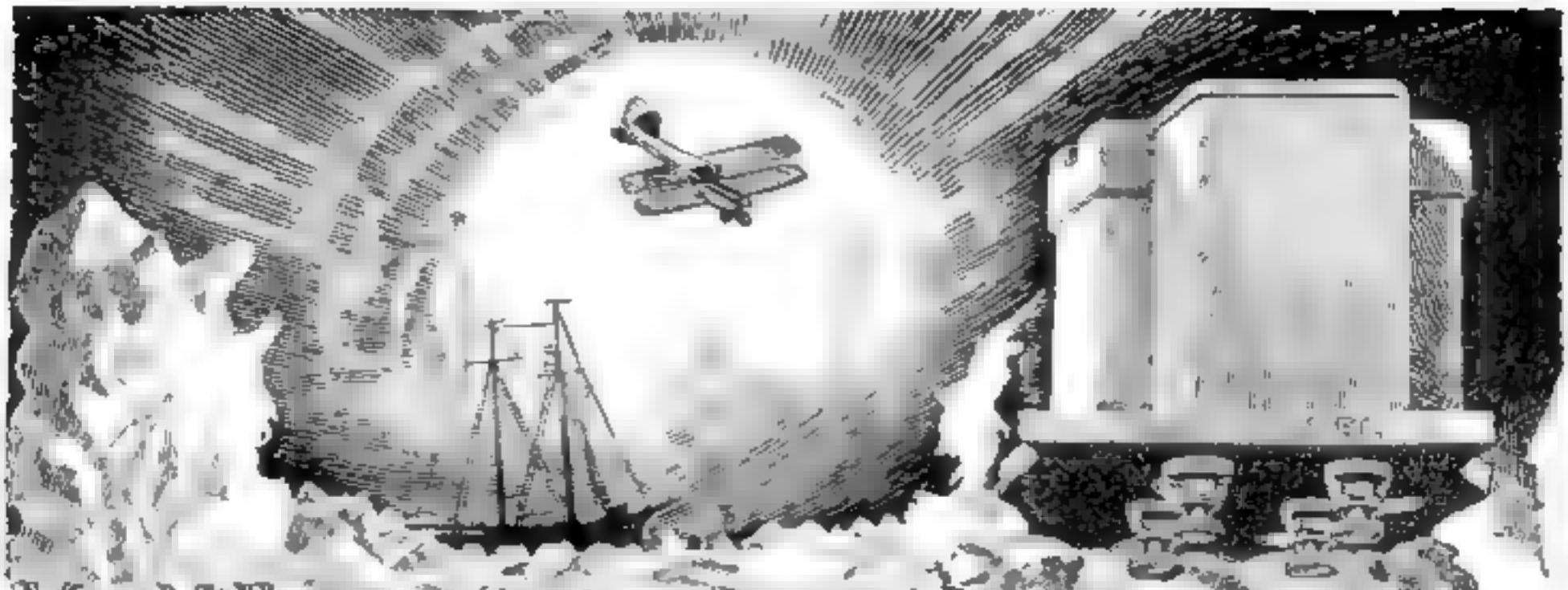


Details of the mechanism, one view showing the leaves raised and the other partly lowered

such an angle that it will be as far over to one side of the tea wagon as possible when the leaves are down. A study of the illustrations will show the relation of these parts. A hole is bored through the joint to suit the projecting bolt in the pivot block.

The side blocks are screwed on the leaves, the slope of one block facing in

(Continued on page 88)



MacMillan received and sent with Thordarson Transformers

If you were commissioned to explore the polar regions, you too would be very particular to select the best equipment — especially in radio, your sole means of communication.

ZENITH
KENNEDY
WL
RADIODYNE
CL
Pfanstiehl
Howard
Thermodyne
GLOBE
Deresnadyne
ADLER-ROYAL
MURDOCK
MU-RAD
Valley
Silver-Marshall
OZARKA
ULTRADYNE
Newport
LEICH
NUNN-LANDON
KUSTOMBILT and
many others
use

THORDARSON Super Amplifying Transformers — the identical transformers sold by dealers everywhere and used in a majority of quality sets—have been the exclusive choice of MacMillan on his Arctic expeditions.

Surely no greater tribute can be paid to the actual supremacy of Thordarson Transformers, product of the world's oldest and largest exclusive transformer specialists. Faultlessly they amplified programs and messages from great distances on the 1923-1924 expedition — and came back "as good as new." Equally successful was their performance on the last expedition.

The wisdom of MacMillan's choice is further confirmed by the fact that year after year, leading builders of fine sets — makers of fine instruments especially noted for distance and superb tone qualities—use more Thordarsons than all competitive transformers combined.

In addition to Thordarson audio frequency and power amplifying transformers in his receiving sets, MacMillan chose Thordarson Transformers for exclusive use in his broadcasting station, WAP, on board the Peary. WAP successfully broadcast the weird voices and instruments of Eskimo entertainers back to civilization.

Thordarsons cost more to build — but no more to buy. Dealers everywhere. Interesting bulletins on amplification mailed free.

The Thordarson "Autoformer" All Frequency Amplifiers are our latest development. They amplify clearly the lowest as well as the highest notes of any instrument. An adoption of impedances, resistances and capacities. Write for the Autoformer Hook-up Bulletin—it's free.

Autoformers are $8 each. Other Thordarson Radio Transformers: Audio Frequency (subpanel or top mounting types), 2 1, $5; 3½ 1, $4; 5 1, $4 50. Power Amplifying, $13 the pair. Interstage Power Amplifying, each $8. If dealer cannot supply, order from us.

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

THORDARSON
Super
AMPLIFYING TRANSFORMERS
Standard on the majority of quality sets

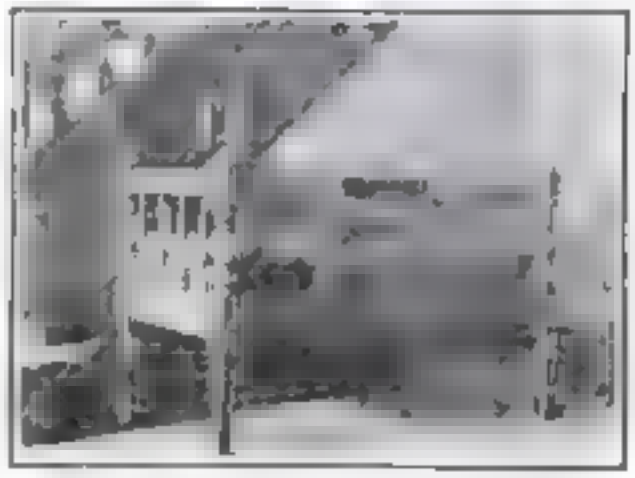
This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

The Home Workshop

Unique Telephone Stand Made from a Discarded Crib

A NEW idea in telephone stands is illustrated below. It is made of a solid black walnut crib in which I slept when a baby

I sawed off the top of the high posts, removed one side, placed slats across the bottom, and made a leather upholstered seat to fit within the rails. The telephone shelf is plate glass backed with green felt,



This telephone stand with its roomy, comfortable upholstered seat was a baby's crib

and below it is a rack for supporting the telephone directory.

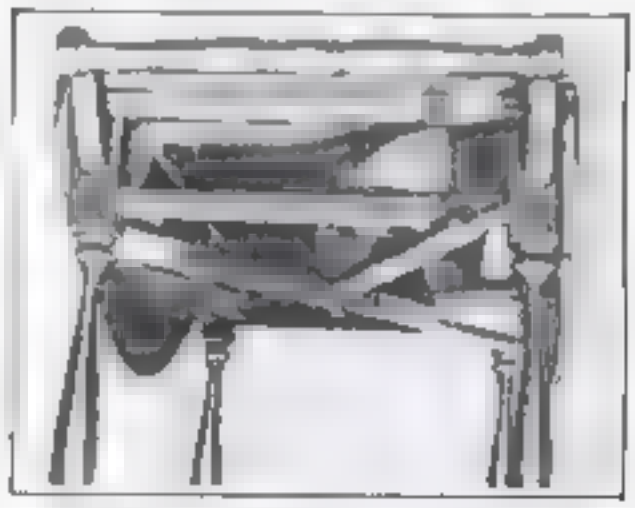
The seat is far more restful for telephoning than the diminutive chairs ordinarily used, and also is a convenience when putting on rubbers or waiting in the reception hall for other members of the household.—Leo A. Reinke.

Automatic Leaf-Raiser for Tea Wagon or Table

(continued from page 86)

the opposite direction from that of the other. The blocks are placed so that the ends of the bar extend about ¾ in. beyond them when the leaves are up.

Bear in mind that the bar should be as long as possible, the length being con-



View of the tea wagon with drawer removed, showing leaf-raiser in lowest position

trolled by the diagonal distance from leaf to leaf when the leaves are down. Make a long slope to the side blocks so that the leaves will rise gradually; otherwise the bar will work hard and may break.

Working details of a tea wagon to which a leaf-raiser of this type can be applied are contained in Home Workshop Blueprint No. 13 (see list of blueprints on page 90).

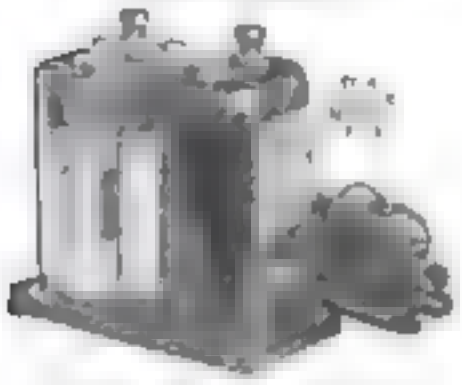
Equip your set with
Balkite Radio Power Units
They provide unfailing, uniform current for both circuits

FOR THE "A" CIRCUIT

Balkite *Battery Charger*

This popular battery charger is entirely noiseless and can be used while the radio set is in operation. If your battery should be low you merely turn on the charger and operate the set. Charging rate 1.5 amperes. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles. Also for 25-40 cycles with 1.5 ampere charging rate.

Price $19.50 *West of Rockies,* $20
In Canada, $27.50



Balkite *Trickle Charger*

Charges both 4 and 6 volt radio "A" batteries at about .5 amperes. Usable in 3 ways: (1) As a regular charger with a low capacity storage battery for sets now using dry cells. (2) With storage battery sets of few tubes. Furnishes more current than used by 6 dry cell or 2 storage battery tubes, so that, if used during operation it need be used at no other time. (3) As a "trickle" or continuous charger for sets of as many as 6 dry cell or storage battery tubes. Charging rate 2.5 amperes. Size 5¼ in. long, 2⅝ in. wide, 5 in. high. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Low capacity batteries especially adapted for use with this charger with sets now using dry cells are being offered by practically all leading battery manufacturers this fall.

Reputable manufacturers are also offering this fall for use with this charger special switches which turn on Balkite "B" and turn off the charger when you turn on your set. This makes the current supply for both "A" and "B" circuits automatic in operation.

Price $10 *West of Rockies,* $10.50
In Canada, $13

Equip your set with Balkite Radio Power Units. They improve and simplify radio reception. With their use your current supply is unfailing and always exactly what is required for each circuit. They reduce the amount of attention you give your set.

The popular Balkite Battery Charger is entirely noiseless and can be used while the set is in operation.

The Balkite Trickle Charger is especially adapted to sets of small "A" current requirements—any dry cell set, and storage battery sets of few tubes. It enables owners of sets now using dry cells to make a most economical installation.

Balkite "B" II is also well known. It was the outstanding development in radio last year. It eliminates "B" batteries and supplies plate current from the light socket. It fits any set.

The new Balkite "B" at $35 is especially designed to serve sets of 6 tubes and less. With such sets it will perform exactly as does Balkite "B" II with sets of larger "B" current requirements.

Noiseless—No bulbs—Permanent

All Balkite Radio Power Units are based on the same principle. All are entirely noiseless in operation. They have no moving parts, no bulbs, and nothing to adjust, break or get out of order. They cannot deteriorate through use or disuse—each is a permanent piece of equipment with nothing to wear out or replace. They require no other attention than the infrequent addition of water. They do not interfere with your set or your neighbor's. Their current consumption is remarkably low. They require no changes or additions to your set. They constitute a complete, trouble-free radio power equipment, one that is economical, unfailing in operation, and eliminates the possibility of run-down batteries.

Manufactured by
FANSTEEL PRODUCTS COMPANY, Inc.
North Chicago, Illinois

FANSTEEL
Balkite
Radio Power Units

FOR THE "B" CIRCUIT

Balkite "B"

Eliminates "B" Batteries. Supplies plate current from the light socket. Operates with either storage battery or dry cell tubes. Keeps "B" circuit always operating at maximum efficiency, for with its use the plate current supply is never low. Requires no changes or additions to your set. No bulbs—nothing to replace. Requires no attention other than adding water twice a year.

A new model, designed to serve sets requiring not more than 20 milliamperes at 90 volts—practically all sets of 5 tubes or less, and most 6 tube sets. Size 8 ¼ in. long, 8 in. high, 3¼ in. wide. Occupies about same space as 45 volt dry "B" battery. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price $35
In Canada, $47.50

Balkite "B" II

The most outstanding development in Radio last season. Same as the new Balkite "B" but will fit any set including those of 8 tubes or more. Current capacity 40 milliamperes at 90 volts. Size 9 in. high, 6 ¾ in. wide, 7⅛ in. deep. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price $55
In Canada, $75

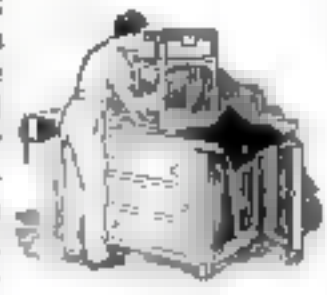
The Unipower, manufactured by the Gould Storage Battery Company, is equipped with a special Balkite Radio Power Unit.

BALKITE BATTERY CHARGER · BALKITE TRICKLE CHARGER · BALKITE "B" · BALKITE "B" II

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Suggestions for Constructing Valuable Christmas Gifts



FURNITURE and radio sets rank among the most durable and satisfactory Christmas presents. They have real utility and give lasting pleasure to those who receive them

Gifts of this type can be constructed economically in even the most modestly equipped home workshop. To guard against disappointment in the finished product, however, it is advisable to follow well-worked-out plans such as those contained in the Home Workshop series of blueprints, listed below

If you wish to make a useful present for your wife or mother, you can choose such pieces as the sewing table (1), the kitchen cabinet (5), the tea wagon (13), or a chest (17 and 39). If the gift is for a man, you can select the smoking cabinet 2); for a man or boy, the bench (15) or a radio set (41, 42, and 43,, or if for children, a variety of toys (14 and 29)

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN

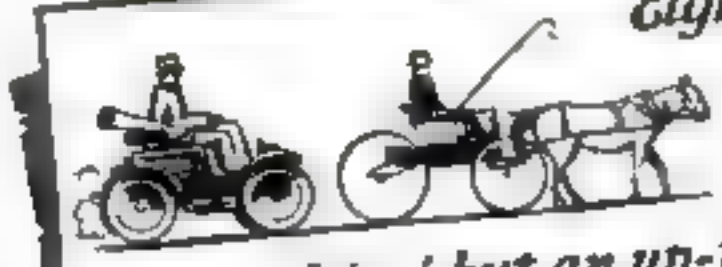
Send me the blueprint, or blueprints, I have underlined below, for which I inclose cents

No.	Title	Issue	Price
1	Sewing Table	Feb. '22	25c
2	Smoking Cabinet	Mar '22	25c
3	End Table	Apr '22	25c
5.	Kitchen Cabinet	May '22	25c
6.	Shaving Cabinet	June '22	25c
9	Arbor Gate and Seats	July '22	25c
10	Porch Swing	Aug '22	25c
11	Bench and Tilt Table	Sept '22	25c
12	Electric Wa[illegible]	Oct '22	25c
13.	Tea Wagon	Nov '22	25c
14.	Christmas Toys	Dec. '22	25c
15	Workshop Bench	Jan '23	25c
16.	Inlaid Radio Cabinet	Feb. '23	25c
17	Cedar Chest	Mar '23	25c
18.	Phone Table and Stool	Mar '23	25c
19	Grandfather's Clock	Apr. '23	25c
20	Flat Top Desk	Apr. '23	25c
21	Colonial Desk	Apr. '23	25c
22.	Cabinet and Desk	Apr. '23	25c
23.	Pergola Garage	May '23	25c
24	Gateleg Table	June '23	25c
25.	Canoe Sailing Outfit	July '23	25c
26	Baby's Crib and Pen	Sept. '23	25c
2	Kitchen Cabinet Table	Oct '23	25c
28	Pullman Play Table	Nov. '23	25c
29	Toy Tea Cart etc.	Dec. '23	25c
30	Tool Cabinet etc.	Jan. '24	25c
31	Sewing Cabinets	Feb. '24	25c
32	Chinese Game Table	Mar '24	25c
33	Dining Alcove	Apr '24	25c
34.	Garden Trellises	May '24	25c
35.	Simple Radio Cabinet	Oct '24	25c
36.	Rush Bottom Chair	Nov '24	25c
37	Simplified Bookcase	Dec. '24	25c
38	Sheraton Table	Jan. '25	25c
39	Salem Chest	Feb. '25	25c
40.	Desk in Sheraton Style	Mar '25	25c
41	One Tube Radio Set	May '25	25c
42	Three Stage Amplifier	June. 25	25c
43.	Four Tube Receiver	July. '25	25c

Name .....
(Please print)

Street .....

City and State .....



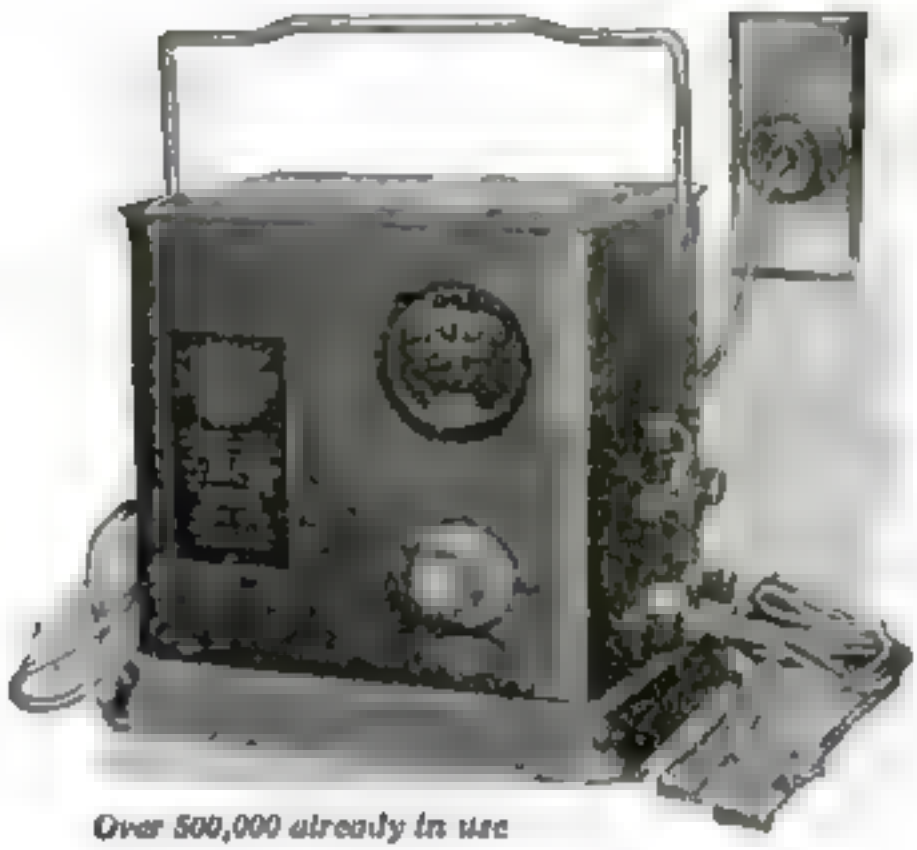
Eight miles an hour used to be the speed limit. Old-fashioned, slow battery chargers cannot charge over 2-amperes an hour

Buy nothing but an up-to-date 5-ampere charger!

The New Improved

5 AMP. A & B GOLD SEAL HOMCHARGER

$19.50



Over 500,000 already in use

Three Times as Fast!

Better Because:—

New micrometer adjustment, hinged lid, and carrying handle.

No bulbs to buy or break

Can be used anywhere—contains no acids or other harmful liquids to spill.

Approved by underwriters—trouble-proof, shock-proof and fireproof

Beautiful cabinet in maroon and gold.

Free *Write for new edition of our instructive booklet on radio operation "The Secret of Distance and Volume in Radio."*

No more of the long, bothersome waits that were necessary when the slow, 2-ampere battery charger was the best that radio offered.

The New Improved 5-ampere GOLD SEAL HOMCHARGER charges your battery overnight—it charges three times as fast as the slow, obsolete chargers that were last year's best. **And it charges both A and B batteries without additional equipment.**

Don't let anybody sell you an obsolete slow 2-ampere charger. You need a full 5-ampere charging rate for real efficient service. To be *absolutely sure*, insist on the GOLD SEAL HOMCHARGER.

The Kodel Radio Corporation

500 East Pearl Street Cincinnati, Ohio

WKRC

Owners of Kodel Broadcasting Station WKRC on the Alms Hotel. Send for program.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See age 6.

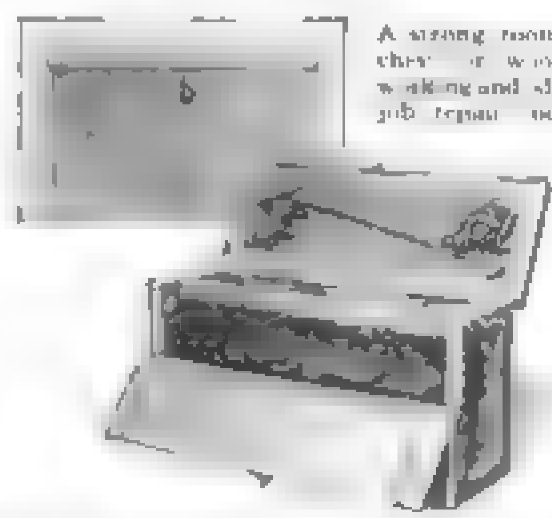
The Home Workshop

General Utility Toolbox of Rainproof Construction

BUILT especially to be carried in a Ford car, the carpenter's toolbox illustrated is an especially handy size and has the advantage of being waterproof It is also an excellent toolchest for the home owner or farmer.

The top and bottom are ⅞ by 12 by 31 in. and 10 by 31 in. respectively, the ends ⅞ by 10 by 18 in., the front and back each are composed of 2 pieces ⅞ by 10 by 31 in., all being ⅞-in. dressed pine.

The end pieces are prepared first by nailing around their outside edges strips ⅞ by 1¼ in. Then nail the bottom board to the end pieces. Take the two front pieces and bevel one edge on each piece so that the joint where they come together will slant downward to prevent the rain from beating in. Nail the lower



A strong, roomy chest for wood working and odd job repair tools

front piece on and then attach the upper piece with hinges. Bevel the joint between the two back pieces in the same way and nail them on.

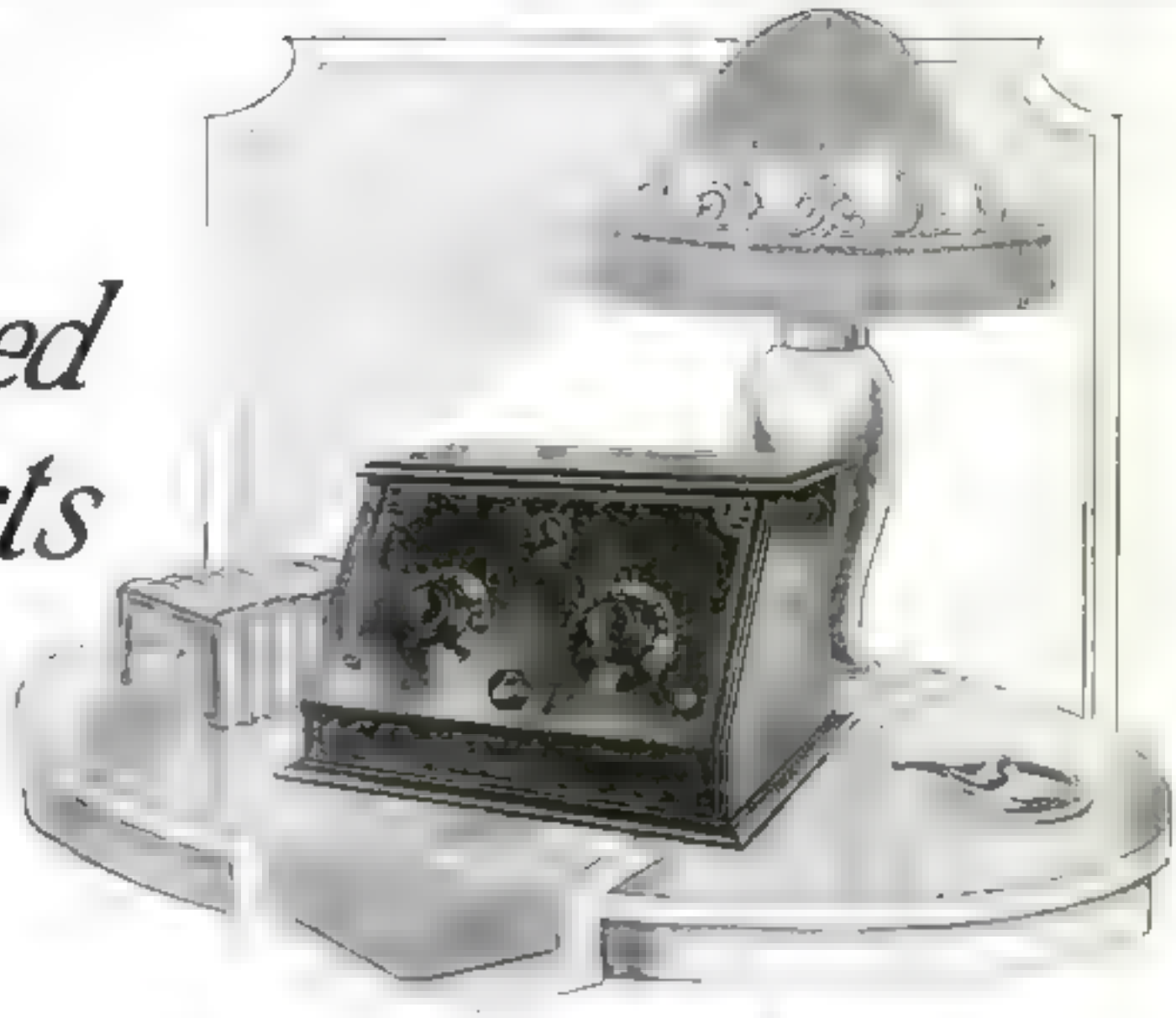
The lid should have four ⅞ by 1¼ in. strips nailed around the inside to keep it from warping. Fit hinges and hasp Then take several laths, round one edge of each, and fit and nail them around the edges of the lid, letting the rounded edge project about ¼ in. below the top of the box. Cut a piece of galvanized iron large enough to cover the top and bend down over these laths. If no sheet-metal shop is at hand, make the two longer bends yourself by bending the metal between two planks. Then place the metal on the box and bend down the ends, lapping the corners and nailing the edges with galvanized shingle nails. Paint the box inside and out.

Two saw racks may be fitted in the lid and a small tray provided for bits, rules, and small tools.—THOMAS STALLINGS.

New Ideas for Your Christmas Gifts

NOVEL methods of preparing Christmas decorations will be featured in the Home Workshop Department next month. There will be an especially large number of suggestions on making toys and games. A page or more will be devoted to stunts you can do with a toy electric railroad. Other articles will describe gift furniture.

The Improved Roberts



Approved by Ten leading manufacturers

$60.85 Cabinet Extra

The new Hammarlund-Roberts receiver is the united achievement of ten leading engineers, endorsed by ten of the best-known radio manufacturers. No one man's or one group's conception of five tube possibilities but the composite of the leaders' convictions.

This concentration of the leaders upon one purpose—the perfection and intense application of tried and proven radio principles has produced new results. Results so vital and so valuable that they put the Hammarlund-Roberts far beyond your expectations of performance.

In designing this new standard of efficiency, the consulting engineers had at their disposal the finest parts the market affords—regardless of cost. They were not handicapped in building to a price.

These ten leading manufacturers offer to the American public greater value than ever before. A radio receiver constructed throughout of the latest, most efficient part designs at a price within the means of every one. A five tube receiver that equals the Super Heterodyne in selectivity and volume. A receiver so simple in design that anyone can build it from the instructions in the "Hammarlund-Roberts Construction Book". You will wonder at this new simplicity, this new efficiency, this new saving.

Send for this most complete book giving full instructions on assembling, wiring, and operating the Hammarlund-Roberts receiver.

Associate Manufacturers

All-American Radio Corp. Alden Manufacturing Co., Radiall Company, Carter Radio Company, Dubilier Condensers, Union Radio Corp., International Resistance Co., Hammarlund Mfg. Co., Inc.

Write for this most complete book

25c

Nickeled sockets and dials, Carter Rheostats, Jacks and Switches approved for the Hammarlund-Roberts.

Hammarlund-Roberts, 1182-F Broadway, N.Y.

Hammarlund Roberts

The All-American Radio Corp. contributes the Rauland Lyric Transformer to the efficiency of this new receiver.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Playing Host *to the* Birds

By William J. Edmonds, Jr.

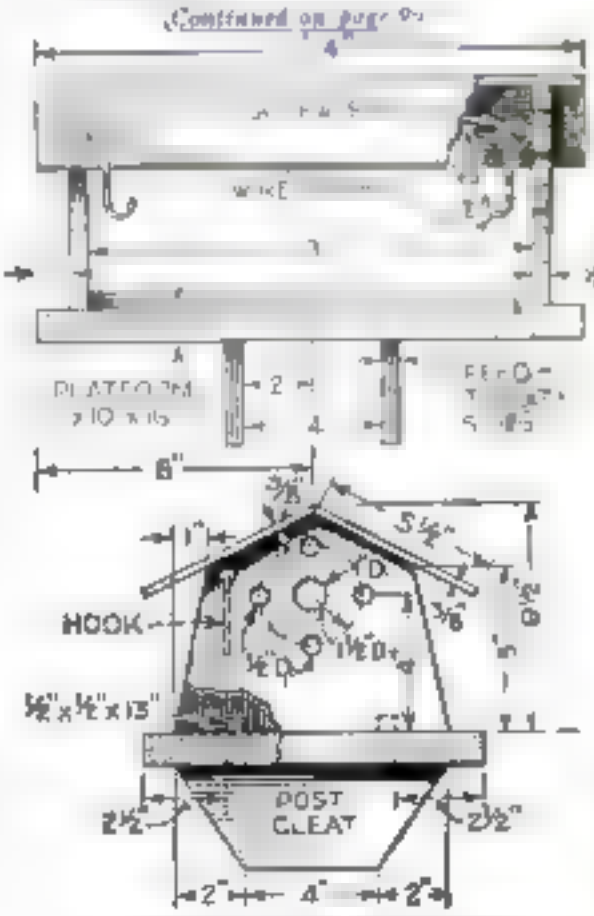
YOU can play host to a surprising number of birds this winter if you spend the small amount of time necessary to make a simple bird-feeding shelter and keep it well stocked with suet and seeds all through the cold months.

The shelter illustrated is not only substantial and well designed for its purpose, but also is sufficiently simple in construction to be made by any one with the common tools found in every household.

Almost any kind of wood can be used, but white pine, cedar, or cypress are easy to work and have excellent weathering qualities. If easier to obtain, material ¾ in. thick can be used for the parts indicated as ⅞ in. thick in the drawing below

In assembling the parts, the post cleats should be fastened in place first with at least three screws fastened through the bottom into each cleat. The cleats, which should be spaced to suit the post or other support, prevent the platform from warping

Continued on page 94



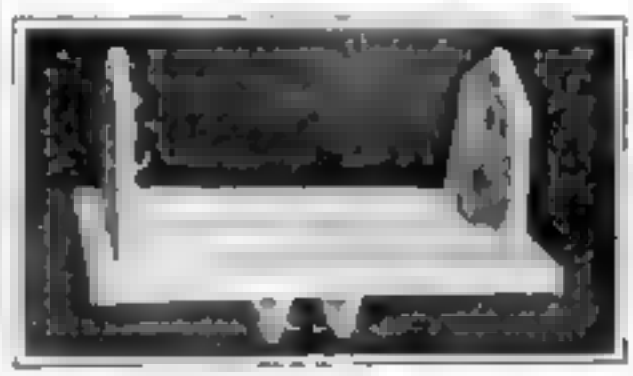
Side and end views of a simply made feeding table or shelter for encouraging winter birds

Playing Host to the Birds

(Continued from page 94)

The ends are fastened to the platform with finishing nails driven from the under side. The ¾-in. square strips, which prevent the seeds from being blown off the platform, are fastened with brads parallel to each other. The suet hooks are screwed into the inside surface of each end before the roof boards are nailed in place.

The feeding-table may be painted any color that blends with its surroundings.



The separate parts (upper view) and the shelter assembled ready for placing the roof

Brown or green always are satisfactory colors.

The ends should face in the direction of the prevailing storms to lessen the danger of the table's becoming filled with snow.

Lumps of suet should be kept constantly on the hooks, as it attracts more birds than any other food. Bread crumbs, seeds, and broken nuts are relished by many birds.

Giving Photos a High Gloss

PROFESSIONAL photographers obtain high gloss effects on photographs by allowing the prints to dry on polished ferrotype plates. The amateur can do the same thing in the way illustrated.

When removed from the bath, the prints should be placed face down on

The prints are allowed to dry face down on the polished bottom of a developing-tray

the bottom of a developing tray and the excess water removed with a blotter and roller. Polishing the tray bottom beforehand with a soft cloth on which a small quantity of wax has been rubbed, will prevent the prints from sticking.—K. B. M.

See how easy to build this amazing new type radio

WRITE immediately for the free radio book just published. It tells how thousands are enjoying the revolutionary new radio principle at a great saving by building their own sets. How 45 minutes of fun gives you a receiver that rivals in results the costliest factory built jobs. Now anyone can do it a new easy way

Science has made a remarkable discovery. A new inductance principle that offers 4 great improvements over ordinary sets. It is based on a new kind of coil, the Erla *Balloon *Circloid. Only Erla can give it to you. See these 4 striking results.

1. ***Greater Distance.*** Circloids have no measurable external field to affect adjacent coils or wiring circuits. This makes possible higher amplification in each stage, with increased sensitivity and greater range.

2. ***More Volume.*** Higher r. f. amplification enables Circloids to bring in distant stations scarcely audible in ordinary sets with volume enough on the loud speaker to fill an auditorium.

3. ***Increased Selectivity.*** Circloids have absolutely no pick-up qualities of their own. Only signals flowing in the antenna circuit are built up.

4. ***Finer Tone Quality.*** The self-enclosed field positively prevents stray feed-backs between coils. Hence no blurring or distortion. Tones are crystal clear

Write for free information on kit—also book

See how a few minutes of fun will give you the newest and most phenomenal set known to radio science. Examine it at any Erla dealer's, or send the coupon for full information, illustrations and diagrams contained in the remarkable new book, "Circloid Hookups."

NOW FREE

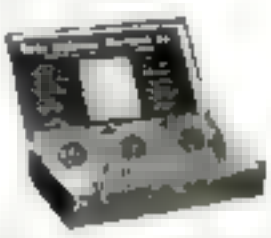
Get this book telling about the newest scientific radio discovery. See the many circuits in which it can be used. See how to make the tests that prove conclusively the great advantages it brings. The edition is limited, so write immediately.

*Trade Mark Registered

Erla Kit No. K-10

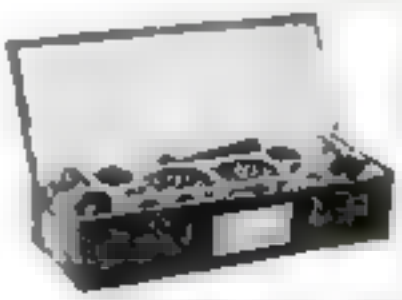
Consists of 3 Erla Balloon Circloids (1 coupler and 2 transformers). Full instructions for installing on your present receiver are included. **Price $15.**

Erla Kit No. K-13



Consists of 5 Erla Balloon Circloids (1 coupler and 4 transformers) and 3 .0005 15-plate Erla Midget Condensers. Complete instructions for installing in each box. This combination gives you a superior 3 tube receiver. **Price $21.50.**

Erla 3 Tube Circloid Cir-Kit



Contains absolutely every part used in the construction of a 3-tube Erla receiver, from drilled and engraved Bakelite panel and sterilized baseboard to wood screws and wire. Every part tested and approved in our laboratories and guaranteed.

ELECTRICAL RESEARCH LABORATORIES
2500 Cottage Grove Avenue, Chicago, Ill.

This sign identifies authorized Erla distributors. All are equipped to give complete radio service.

Dealers—Exclusive franchises are available to high class dealers in localities still open. Write or wire immediately.

ELECTRICAL RESEARCH LABORATORIES,
2500 Cottage Grove Ave., Dept. 12 B Chicago, Ill.

Send me the new book explaining the revolutionary radio principle recently discovered, also various Circloid hookups.

Name .....

Address .....

City ..... (County) ..... State .....

The Home Workshop

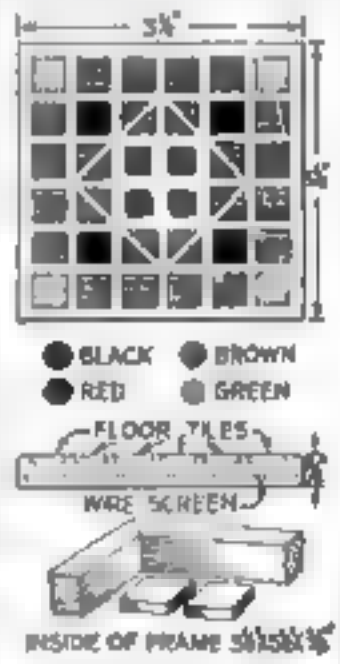
Decorative Teapot Stand Made from Mosaic Floor Tiles

ORDINARY mosaic tiling is a material useful for making many novel and decorative objects in the home workshop. As modern office buildings have floors in which these tiles play a prominent part, the material may be obtained easily and at comparatively low cost.

This unique and colorful stand for hot dishes is made of small tiles set in cement. It requires no baking as do pottery tiles

To construct a teapot stand from mosaic pieces, a frame is required. It should be ⅝ in. deep, having inside dimensions of 5½ by 5¼ in. This frame is given a coat of oil or white lead to prevent the cement from sticking to it. The frame is placed on a small board or table perfectly horizontal and the tiles are arranged to make any design or pattern.

After the tiles are arranged, Portland cement and fine sifted sand are mixed in equal parts with sufficient water to pour easily. This is poured into the frame to cover the tiles about ⅛ in. A reinforcing sheet of window screen 6 in. square then is placed in the mold, after which the remainder is filled with mortar.



How the form and the tile are made

The mortar may be left natural or colored either with cement colors or aniline, water-soluble powdered dye, such as can be purchased at any drug-store.

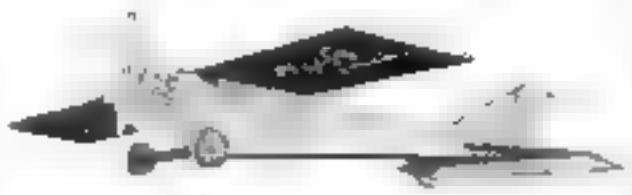
After the mortar has hardened sufficiently, the frame is removed and the edges are smoothed up by means of a carborundum stone or a file. When the cement is stone dry, the edges may be enameled.—W. J. E.

Likes the Home Workshop

I HAVE been taking POPULAR SCIENCE MONTHLY for two years, and can truthfully say that it is the best magazine that can be bought. The Home Workshop Department has helped me a great deal, for my hobby is woodworking.—R. W. D., Fond du Lac, Wis.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

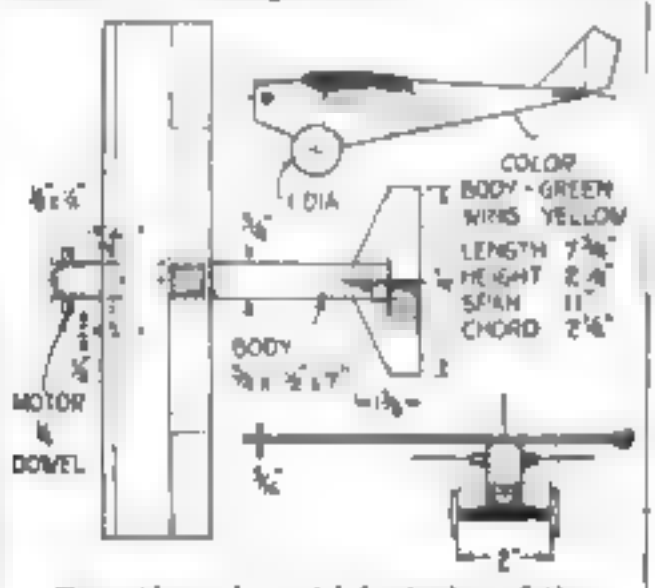
Toy "Air Flivver" Whittled from Scraps of Soft Wood



WHILE the day of the "air flivver" is not yet here, there seems little doubt that it is close at hand. Therefore a plane of this type should be included in every boy's collection of toy airplanes.

Nothing could be much easier to make than the model air flivver illustrated The body is cut from a piece of soft pine or other wood ¾ by 1¼ by 7 in. The wing is shaped from a piece 3/16 by 2½ by 11 in. A ¼-in. dowel is glued in a hole through the nose of the machine so that the ends project 5/16 in. beyond each side of the body. This represents the simplified, light airplane motor of the future

A strip ¾ by ¼ by 2 in. is nailed beneath the body to serve as an axle



Top, side, and partial front view of the toy plane, showing the principal dimensions

It carries two wheels ⅜ in. thick and 1 in. in diameter cut from a curtain pole.

The tail members and the propeller are tin, as in previous models, and the tail skid is a piece of bent wire

This is the last airplane toy in the present series. A complete set, attractively painted, would make an especially welcome Christmas gift for any small boy, and the actual work of constructing them is relatively slight. The cost is nothing at all, except for paint.

In case you wish to build the entire series, you will find the first design, a toy air coach, on page 100 in the June issue; the second, a flying-boat cruiser, on page 103, July; the third, a racer, on page 89, August, the fourth, an aerial express cruiser, on page 109, September, and the fifth, a transatlantic air-liner on page 112, October

A quick-drying, glossy, and brilliant paint for toys of this type can be made cheaply by purchasing a few cents' worth each of powdered whiting, lampblack, and bright red, blue, and yellow at a paint-store and mixing the colors as needed with white or orange shellac. A great variety of colors can be obtained by judicious mixing the powders and there is no waste.—DONALD W CLARK

The Home Workshop

How to Build Book-Shelves without Wasting Space

By Roger L. Bridgeman

WHEN we moved into our newly acquired home, we found no place to put our books. Lining up the books side by side, the surplus from our sectional bookcase measured over 45 ft.

Instead of building shelves and fitting our books into them, we designed the shelves to fit the books. We laid out the volumes on the floor according to height and found the spaces between the shelves that would best suit them would be 8½, 9, and 11 in. The volumes averaged in height an inch less than the space.

The three heights were added, together with the thicknesses of the shelves, and a 1½-in. space was allowed between the bottom shelf and floor, giving 34 in. as the distance from the upper shelf to the floor. The ends of the book-shelves were designed to go above the top shelf 4 in. to accommodate a few small books in the corners.

The books were measured before these shelves were built to insure a place for every volume

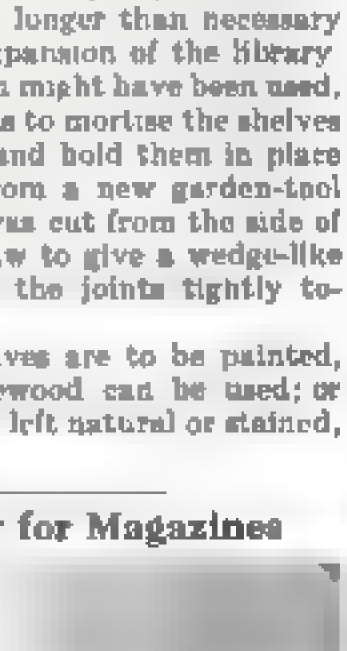
By dividing the total length of the books by three, it was found that shelves totaling 15 ft. in length were required. As we had 18 ft. of wall space, the shelves were made a little longer than necessary to allow for the expansion of the library.

Any construction might have been used, but that chosen was to mortise the shelves through the ends and hold them in place with pins made from a new garden-tool handle. A piece was cut from the side of each peg with a saw to give a wedge-like effect for drawing the joints tightly together.

If the book-shelves are to be painted, white pine or whitewood can be used; or if the wood is to be left natural or stained, use oak or ash.

Shop Holder for Magazines

WHEN making something in the shop from an article in POPULAR SCIENCE MONTHLY I find the best way to prevent the magazine from getting soiled is to hang it above the bench with the type of trousers hanger shown. H. E. B.



A trousers hanger holds magazine open

E. H. HARRIMAN
America's Master Railroad Organizer
Wide-awake boys operating Lionel Model Railroad Systems today, are planning to be the railroad leaders of the future.

"Why, It Looks Real!"

Of course a Lionel Railroad looks real.

It *is* real. The only difference between Lionel and real trains is the size.

Lionel Engineers take care of that. They design and build Lionel Railroads electrically and mechanically perfect, so that they run like real railroads. They work from the engineers' drawings and blueprints of real railroad locomotives, coaches, freight cars, signals, crossing gates and the many other railroad accessories.

Lionel Model Railroads are way beyond ordinary "toy railroads." They are valuable educators. They are helping American boys to learn how real railroads are run, how the passengers and freight of the nation are transported.

Running a Lionel Model Railroad is exactly like running a real railroad.

This wonderful realism can be found only in Lionel Model Railroads and Accessories.

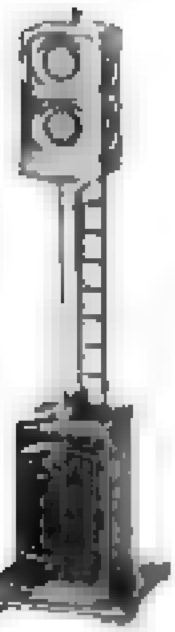
That's why American boys buy more Lionel Trains than any other make. That's why Lionel has been "Standard of the World" since 1900.

Lionel Model Railroads and Accessories are displayed at all of the best stores. Take father and mother with you to see them and remember: Lionel trains are lowest in price consistent with high quality—complete outfits from $5.75 up.

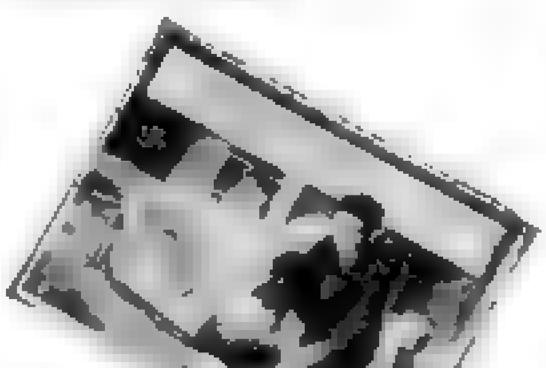
Write today for your copy of the beautiful new 44-page Lionel catalog illustrated in actual colors. It shows the complete Lionel line. Sent free on request.

The LIONEL CORPORATION
Dept. B 48-52 E. 21st STREET
NEW YORK CITY

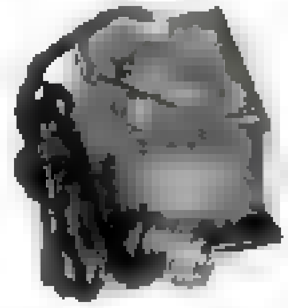
No miniature railroad is complete without the new Lionel Automatic Crossing Gates. Down goes the gate as the train approaches—up again when the train has passed. It works by itself — just like the real ones.



Lionel Automatic Train Control. The greatest achievement in model railroad engineering. Starts and stops trains automatically. Just one of the many wonderful realistic railroad devices in the Lionel line of Accessories.



Be sure to send a post card today for this wonderful 44-page catalog beautifully illustrated in 4 colors. It is FREE.



Lionel "Multivolt" Transformers- Ever-reliable power plants. Run all trains best. A type for every size train.

"STANDARD OF THE WORLD SINCE 1900"

LIONEL ELECTRIC TRAINS
MODEL RAILROAD ACCESSORIES
"MULTIVOLT" TRANSFORMERS

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Greeting Cards "Written" with a Pocket-Knife

NOVEL name and greeting cards can be made quite easily by cutting the lettering and ornamentation into a good quality bristol board or cardboard with a sharp pocket-knife.

The cuts are made at an acute angle to the surface and do not, of course, penetrate right through the card. They simply raise a series of sharp edges, each

Photographic reproduction of a unique card in which the lines are cut with a pen-knife

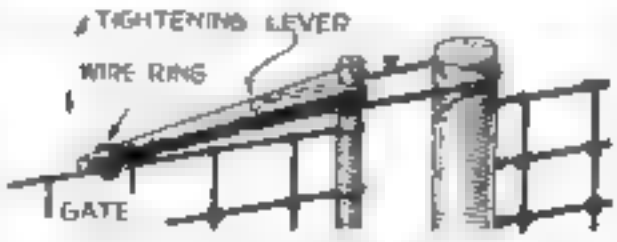
of which throws a shadow and helps bring out the design. The effect is shown clearly in the accompanying reproduction of a card 3½ by 5½ in., which was cut in 15 minutes by Elisha H. Wilkins, of Wallace, Idaho.

The straight lines in this decorative lettering are made with single cuts, but the cross lines are worked out mainly by a series of short cuts placed close together. The crispness and delicacy of the lettering obtained in this way is surprising and, of course, cannot be appreciated fully from the photograph.

Tightening a Wire Gate

SAGGING gates often mar the appearance of an otherwise well kept wire fence. Especially is this true when the gates are of considerable length

A quickly made tightener for a gate can by made from a short piece of wire and a stick as shown. One end of the stick is hollowed to conform to the shape of the gate post and the other end is tapered slightly. A piece of wire is inserted through a hole in the middle



Only a wooden lever a length of wire, and a ring are needed to make this gate tightener

of the stick and wrapped around the fence post.

To tighten the gate, the stick is drawn down and held by means of a wire ring.

JONAS J BYBERG.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 4.

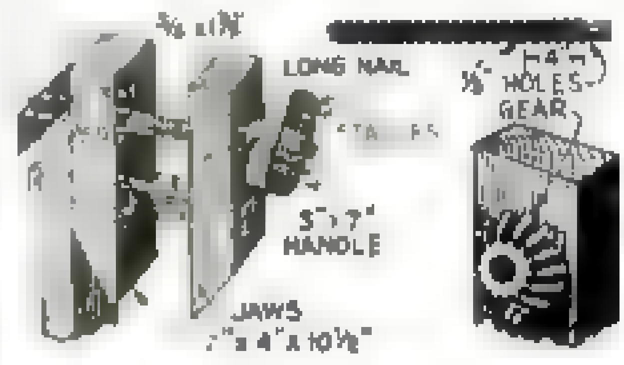
The Home Workshop

Small Woodworking Vise Made from an Old Auto Jack

FROM a discarded automobile jack of the screw type and some odds and ends, I made the useful bench vise illustrated.

Two pieces of hard wood 2 by 4 by 10½ in. are cut as shown to form jaws. A hardwood strip ⅜ by 1⅝ in. and as long as the jack screw, is mortised solidly into the lower part of the outer jaw and pinned in place. This strip, which slides through a slightly larger mortise in the rear jaw, has a series of holes drilled in it to take a large nail. The nail is placed, when the vise is in use, in whichever hole is most suitable for the work in hand, the purpose being to keep the outer vise jaw from turning and, at the same time, parallel to the rear jaw.

A hardwood handle ⅞ by 3 by 7 in. is fastened to the jack screw by means of



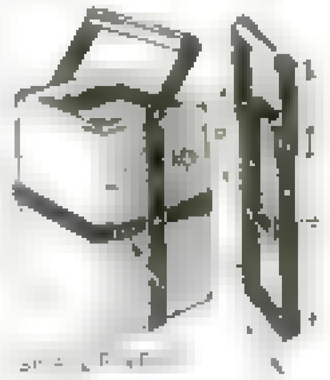
How the parts of a light screw jack are utilized in assembling a bench vise

3 washers, 2 nails, and 2 staples as shown. The nut for the vise screw, which also is a part of the original jack, is fastened with screws at the back of the rear jaw. After the vise is assembled it is bolted to the bench.—E. D. THADDEUS

Folding Carrier for Oilcan

EMPTY 5-gal. motor oilcans, which nowadays are so common around farms, can be transformed with little trouble into buckets for carrying water, feed, and various supplies.

To make a collapsible carrier for this type of can, get about 8 ft. of 1-in. hoop iron and half a dozen small copper rivets. Cut two strips 5 in. long and two 3 ft. long. These are bent and riveted as shown and a wooden handle added. When not in use, the carrier should be folded and stored indoors or otherwise well painted to prevent rust.—A. E. ZIPPRICH



Oilcan carrier

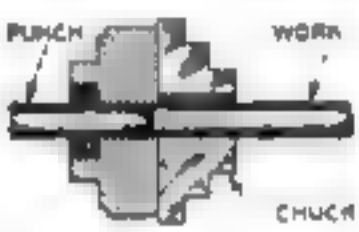
How to Center Work Quickly for Turning in Lathe

By Howard Greene

CENTERING small work in a lathe differs from and is more difficult than centering rods or bars from ¾ in. up. The main trouble is that once the punch mark is made, it is hard to change its position, especially if only a slight adjustment is necessary.

This difficulty can be overcome and much time saved by the use of a self-centering chuck and a special punch. The principle is the same as that used in bell centering punches; but if a chuck is available, it is as good and in some respects better and will handle larger work. One advantage is that it makes no difference if the end of the rod is not square cut, although in all cases it should be squared up before being put in the lathe, and the very first turning operation should be to face the end properly down to the lathe center.

The chuck has a hole clear through the body. In the case of a 2-in. chuck the smallest size, the hole is ½ in. Make a steel center punch of whatever size the hole in the chuck is, and have it a very good fit, so that it will go in easily but without any looseness. Turn the point in the lathe so that it will be exactly in the center and make the angle the same as that of the lathe centers. Then, if the work is very light, the punched centers can be used without drilling. For good work, however, and for the protection of the lathe centers, it is better to drill, so that the lathe centers will not have their extreme points worn.



Punch used with self-centering lathe chuck

CLAMP the rod in the chuck, pass the punch through the hole in the back until the point rests on the end of the rod, put the other end of the rod on your anvil or something solid, and give the punch a light tap, and the job is done.

For a rod under ½ in. it is better to use the outside jaws of the chuck. Obviously, any work up to the full capacity of the chuck can be centered. The chuck is not harmed in any way, provided the projecting end of the rod is always supported when using the hammer on the punch.

If the chuck is mounted on a plug that fits into the taper hole in the spindle, so that the hole in the chuck is filled up, it still is possible to work the scheme, though not quite so well. A very short punch may be made, merely a cone that can be slipped into the chuck from the front, point out. Then put the rod in the chuck, with the jaws screwed in only enough to steady the rod, and press hard against the punch point. This will make a good mark that readily can be deepened afterward. Using a hammer would be likely to start the plug and throw the chuck out of truth on its mounting.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Druggist Builds Machine Tools for Amusement

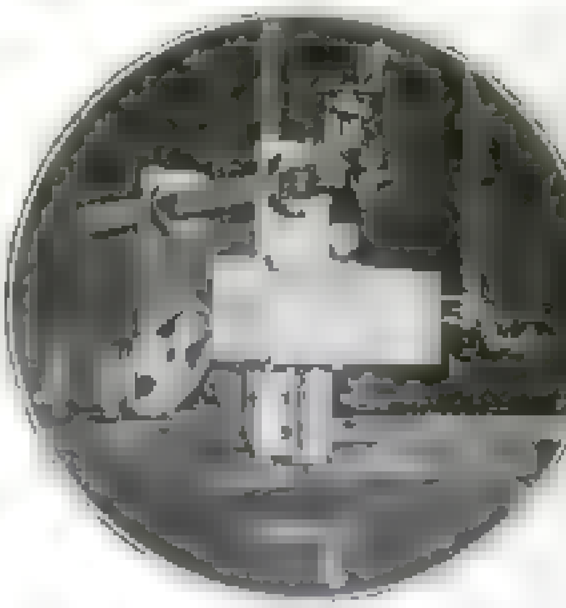
WHAT can be done by the home worker who has had no special mechanical training is well illustrated in the work of B. L. Kemper, a druggist of Perham, Minn., who long has been a reader of POPULAR SCIENCE MONTHLY.

As a boy Mr. Kemper wanted to be a machinist, but never had a chance to become one, as there were no manufacturing industries in his home town. He found his way early into the drug business and, being successful, has remained there ever since.

B. L. Kemper of Perham, Minn., working at the lathe in his small but well equipped shop

In his hours of leisure, Mr. Kemper turned naturally to mechanical work as a hobby. He has built up such a splendidly equipped small workshop that the Editor asked him to tell something about the secrets of his success. He writes as follows:

> I have made it a point never to borrow a tool I could afford to buy. In that way I gradually accumulated quite a nice collection of small tools. The more tools I acquired, the more I enjoyed using them, and the more I used them, the more I wanted. The money I put into my lathe and electric motor, of course, required a real effort, but otherwise the investments in my shop did not hurt much, as I bought a tool only when I needed it.



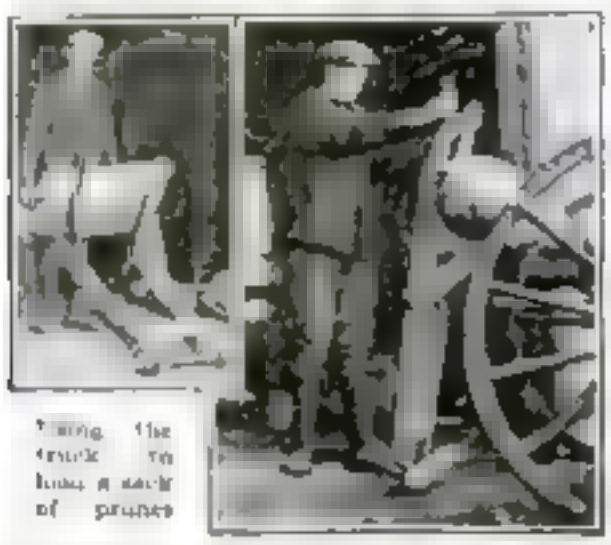
A bench shaper Mr. Kemper is building from plans published in POPULAR SCIENCE MONTHLY

(Continued on page 109)

Special Truck Lessens Labor of Lifting Heavy Sacks

HAVING loaded many 4-ton trucks with well filled sacks of prunes, I felt the need of some labor-saving device to aid in lifting the sacks. The result was the construction of the simple truck illustrated.

This is laid flat on the floor while the sack is tipped on it. Then it is raised by



Tilting the truck to load a sack of prunes

the handles and wheeled to the storehouse door. Here the wheels strike a wooden stop nailed to the floor directly behind the truck. As it comes to a sudden stop, the truck rises to an upright position without any special effort on the part of the operator, so that the sack can be slid directly on the truck. This saves the back-breaking work of lifting the sacks bodily.—J. J. B

Druggist Builds Machines

(Continued from page 168)

The things I make are mostly tools and equipment for my shop. As an example, there is a milling attachment for my lathe, which I built myself, the work being done on an 11-in. lathe of a make advertised in POPULAR SCIENCE MONTHLY. This is a very handy attachment. The material cost me only about $2 and I had several weeks of real fun in building it. The regular manufactured attachment similar to this one sells for something over $40. This attachment has a dovetail slide that swivels to any angle. Together with the compound rest, cross slide, and longitudinal feed of the lathe, I can get nearly any adjustment I want.

One of the photographs shows a shaper that was described in the May, 1923 issue of POPULAR SCIENCE MONTHLY. It is still under construction, but I believe it is going to be a really good machine for its size.

I have made a bandsaw, taps, dies, milling cutters, special lathe centers, drill pads, and mills, boring bars, toys for the kids, real steam engines, and the like.

The fun that Mr. Kemper, as well as so many other readers, get out of their home workshops, is within the reach of any one, no matter how little previous experience he may have had in mechanical work.

Simply by reading the Home Workshop Department regularly, any man or boy who is interested in mechanical work can obtain a comprehensive knowledge of correct methods. Work of this kind is both fascinating and profitable.

The Home Workshop

Unusual Checkerboards Have Attractive Inlaid Borders

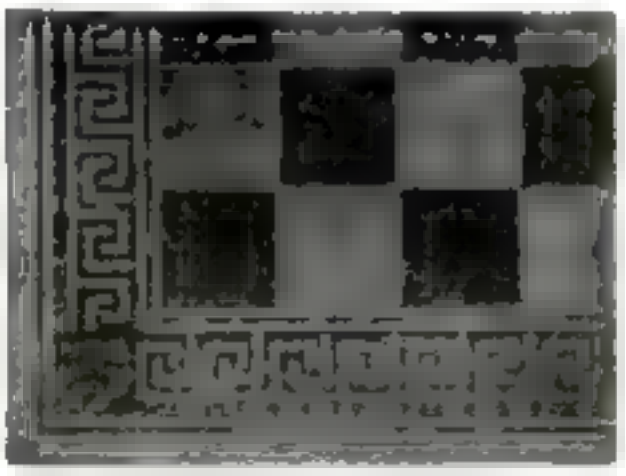
CHECKERBOARDS always offer a fascinating opportunity for a display of woodworking skill. Although they cost little for material, they are esteemed highly as Christmas gifts. If well

Checkerboard with interesting corner treatment by William Weiss of Wheeling, W. Va. It is $\frac{3}{4}$ by 14 by 14 in. and plain on both sides. The woods are walnut oak gum paper birch cedar ash cherry and mahogany

made and carefully finished, they are sure to be treasured for many years.

Making a checkerboard is not nearly as difficult a task as it might appear at first glance. The usual method is to prepare five lengths of walnut or mahogany $\frac{1}{4}$ by 1 $\frac{1}{2}$ by 13 in. and four lengths of birch or some other hard white wood the same size. These are glued together, the light and dark wood alternating to form a board $\frac{3}{4}$ by 13 by 13 $\frac{1}{2}$ in.

When dry, this can be cut across the grain to form eight new strips, each containing nine 1 $\frac{1}{2}$-in. squares. These are planed on the edges, preferably with the



Checkerboard 20$\frac{1}{4}$ in. square, containing 451 pieces of wood, made by J. C. Stamm of Richmond, Ohio. The blocks are black walnut and sycamore interlaced with beech; the border contains walnut maple cherry osage orange sumac and beech. The outside edge which is oak also is inlaid. The whole is glued upon a beech base

and of a shooting board and glued together to form a checkerboard, the odd squares at each end being sawed off.

A border then can be prepared and the whole mounted on a $\frac{3}{8}$-in.-thick board. Another board of the same thickness is screwed on the back with its grain at

Continued on page 111.

Wooden Clamp Aids in Holding Long, Thin Ceiling Boards

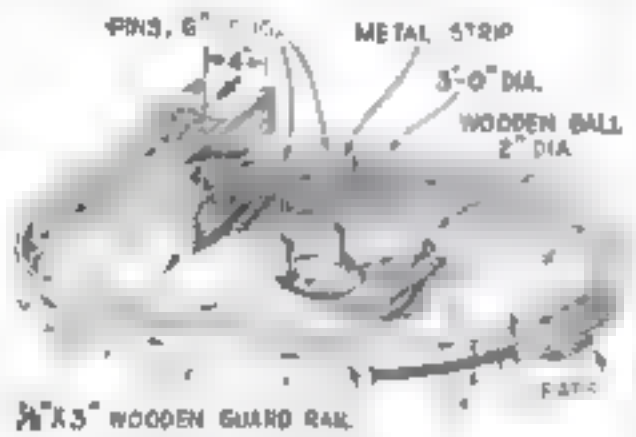
ONE man can put up long, thin ceiling boards 12, 16, or even 18 ft. long in awkward places, as under a porch roof, by using one or more clamps made as shown.

The board to be nailed is held in position for nailing by one or more of the clamps

Each clamp is made of 3 pieces of ceiling or other wood of the same thickness, about 18 in. long. The center piece serves as a handle and spacer; the other two pieces are arms, which hold the board to be nailed in place against those already fastened.—GEORGE T. BROOKS

Tri-Pin Game for Children

CHILDREN have a whirlwind of fun with the naval tri-pin game illustrated. The player rolls a wooden ball swiftly into the trough so that it travels completely around the guard rail and, passing beyond the end of it, rebounds across the board. A fast, lucky shot, in traveling back and forth across the board, may knock down all the pins. The score, of course, depends upon the



The ball is rolled swiftly into the trough to knock down as many pins as possible

number of pins knocked down in the course of the game, the contestants taking turns in rolling the ball

The playing board is ¾ in. thick and 3 ft. in diameter, reinforced underneath with two cleats. The rim and the trough are bordered with a strip of ¼ or 5/16 in. basswood, which should be soaked in hot water to make it bend easily.—D. W. C.

Unusual Inlaid Checkerboards

(Continued from page 110)

right angles, so as to resist any tendency to warp

The use of a border gives a chance for originality in treatment. Inlaid borders are especially attractive and they can be prepared easily by the methods outlined in the article, "Simple Method of Making Inlays for Your Homemade Furniture" (POPULAR SCIENCE MONTHLY, August, page 98)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How to Hang Storm Sash

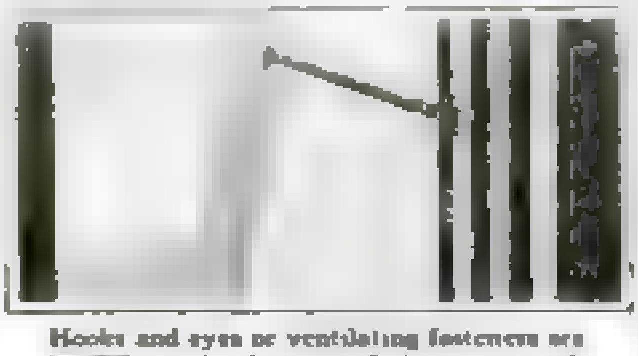
(Continued from page 49)

sill, and the other one giving the width.

If more than two sash are to be hung, it is worth while to make a planing "jack" to hold them. An old board from 6 to 10 in. wide, and from 8 to 10 ft. long can be converted quickly into a jack as shown. If no jack is used, the sash may be placed against the porch steps for planing.

The sides of the sash are fitted first. If 3/16 in. or more must be removed from each side, cut off the surplus wood with a ripsaw. Stand the sash in the frame to check the width and then place it in the jack and plane each side as required. Fit one side at a time. Bevel each edge slightly toward the inside and allow at least 1/16-in. clearance.

When the sides are fitted, stand the sash in the opening and with a block that will reach just above the bottom of the lower rail, gage a pencil line by sliding the block and pencil along



Hooks and eyes or ventilating fasteners are used at the bottom of the storm sash

the sill. With the same block, mark the bevel on both edges to correspond with the slant of the sill. Saw off the bottom to the proper bevel. Crates or boxes will support the sash for sawing if you have no sawhorses.

Again stand the sash on the sill and mark the length. Saw off the top and, if necessary, remove more wood by planing until the sash fits properly.

Screens and storm sash are suspended from the same hangers. If the hangers are not attached already, screw them on the frame directly above the middle of each sash stile or side piece. The sash then is forced slightly against the top of the frame by inserting a chisel or thin wedge beneath the bottom rail. Fasten the eyes in place, using an awl or an automatic drill for starting the screws.

One or two $2\frac{1}{2}$-in. screw hooks and eyes will hold the sash securely at the bottom, but a fastener such as shown above is better in that it permits ventilation, if the storm sash, as often happens, has no ventilator in the lower rail.

On fixed windows, such as stair lights and door side-lights, the storm sash are held in place with small metal buttons.

The simplest method of numbering storm sash and screens is to mark them with Roman numerals cut with a ½- or 1-in. chisel. Start at one corner of the building and number them consecutively to the right or left. A few of the screen rabbets may be marked to correspond to give a key to the scheme of numbering, in case the order is forgotten. If preferred, nails with numbered heads may be used.

The Home Workshop

How to Make Best Use of Glue

(Continued from page 7-f)

filled with water and heated over a gas-burner or stove. There are more expensive pots heated by electricity

Good bristle glue brushes with brass ferrules cost from 60 cents to $1 each, according to size. The dairy type of thermometer costs about $1. Carriage-makers' iron clamps and carpenters' hand screws cost from 40 cents up.

The various utensils used with glue should be cleansed carefully and frequently with boiling water. Small amounts of spoiled glue remaining in the glue-pot or on the brushes greatly weaken and sometimes ruin fresh glue.

When liquid glues are set aside after use, the containers should be closed tightly. If through evaporation the glue becomes too thick, dilute it slightly with clean, warm water. Do not use vinegar

Ground, flake and sheet glues should be kept in a clean, dry place, preferably in a tightly covered container of some sort.

Liquid glue should flow freely from a stick or brush to spread easily

In preparing dry animal glues, the glue should be soaked until soft in clean, cold water. It always should be stirred into the water to insure complete soaking. Sheet glues should be allowed to soak at least 12 hours; flake glues, from 4 to 9 hours, according to thickness of the flakes; and ground glues from 2 to 4 hours. It is advisable to let them all soak overnight or prepare them in the morning if they are to be used during the evening.

The amount of water depends upon the grade of glue. The water-taking quality of hide glues varies from 1½ to 3 parts of water to 1 part of glue. Medium grade hide glues take 2½ parts of water to 1 part glue by weight. While bone glues are not recommended for wood jointing, sometimes they are used and they take only from 1 to 1½ parts of water.

Both hide and bone glues have a wide range of grades, but it pays to use the best glue obtainable.

It always is best to weigh the glue and water each time after the right proportion has been determined. Glue cannot be prepared by guesswork. Animal glue should not be too thick. It is necessary for glue to penetrate into the articles to be glued in order to bind them together If too thick, it jells on the surface.

A pair of scales were not mentioned in the list of equipment as they are expensive. The local store usually will allow you to weigh your glue.

After soaking, the glue should be dissolved in the glue-pot. If the soaking is complete, the glue will melt readily. If all the water has not been absorbed, leave it with the glue in the pot. Be sure there is water in the jacket of the pot.

(Continued on page 114)

The Home Workshop

How to Make Best Use of Glue

(Continued from page 113)

Place the thermometer in the glue and be sure the temperature does not rise above 150° F. Glue does not have to be "cooked" to make it sticky. Heat is simply to dissolve it and to keep it liquid. When the temperature rises above 150° F., glue rapidly loses strength and if this temperature is continued for some time, the glue is ruined.

Casein glues of good grade usually are prepared by stirring rapidly 1 part of glue into 2 parts of cold water by weight. Continued mixing is required until all lumps are broken up. The mixture should stand from 15 to 30 minutes for the completion of the chemical action. Only enough glue for the day should be mixed, as these glues become solid like a piece of cheese after about 12 hours.

The preparation of the articles to be glued is important, especially if wood

Brush the glue on vigorously and be sure to cover well all parts of the joint

The joint should be clean and dry. No wood that has not been thoroughly kiln dried should be used with either animal or fish glues. Wood not thoroughly dried can be glued with casein glue.

The wood should be jointed perfectly before applying glue. Uniform contact between the two pieces must be assured.

When repairing furniture and other articles that have been glued previously, scrape away all old glue and have the joints perfect again before gluing.

In cold weather it always is well to have the parts warm before applying the glue. Animal glue sets quickly and if it jells before the wood comes together firmly, the joint is worthless. When the wood is warm, it retards the "set" and gives the glue a chance to penetrate.

When prepared liquid glue is applied to a joint, it is quite possible to obtain good results by giving one coat of glue to the parts and pressing them together immediately. This is the common way of using liquid glue, but it is not the best way. A little additional pains will insure a very much stronger joint.

First apply a thin coat of liquid glue and allow it to penetrate into the wood. It is not necessary to thin or dilute the glue; simply brush it out thinly. Then apply a second coating and allow the glue to become "tacky" to the finger before pressing the joint together and tightening the clamps, hand screws, wedges, or whatever means of pressure is to be used.

(Continued on page 115)

The Home Workshop

How to Make Best Use of Glue

(Continued from page 114)

In using hand screws, keep the jaws parallel with the wood and use moderate pressure

Liquid glue should not be heated except in cold weather when it has become chilled and is too thick. If the glue then is warmed or heated to a temperature not exceeding from 100 to 120 deg. F., it is in no way injured. It is a common custom when liquid glue is purchased in a can to place the container with the chilled glue in a pan of hot water. It soon becomes liquid enough to apply on any material.

When hot animal glue is used, coat the wood freely on both sides of the joint, press the parts together, and clamp immediately.

When glued wood is placed in the clamps or presses and these are set up, the surface glue is squeezed into the wood as well as out to the surface of the joint. If the proper pressure is applied, the surplus glue is eliminated—that is, the surplus that is not pressed into the grain of the wood. When a joint is broken, no surplus glue should appear on the broken parts. The glue should be forced entirely into the wood or squeezed out.

Casein glues should be applied to both sides of the joint and clamped. Plenty of time can be taken to do this, as these glues set slowly. It is well to wipe off whatever surplus glue is squeezed out in clamping, as casein glue dries like flint.

In setting up wood in the clamps or hand screws, only enough pressure should be used to bring the two pieces firmly together. Too much pressure squeezes most of the glue out. The wood should be allowed to remain in the clamps 24 hours in a dry place.

There are many other purposes for which glue can be used in the home workshop, such as for sizing different materials to give them body and also to cover a surface so other materials to be applied will not penetrate. Much liquid glue also is used in the preparation of plastic art clays.

The suggestions given here have been proved by many years of technical and practical experience. If good glues and materials are used, success is certain.

Experienced woodworkers will note that Mr. Spencer has made no reference to the so-called "rubbed" joints. The omission is intentional. He believes that the method is contrary to all the rules of good gluing and should not be practiced.

Kitchen "Safe" Converted into Clothes-Locker

By J. T. Garver

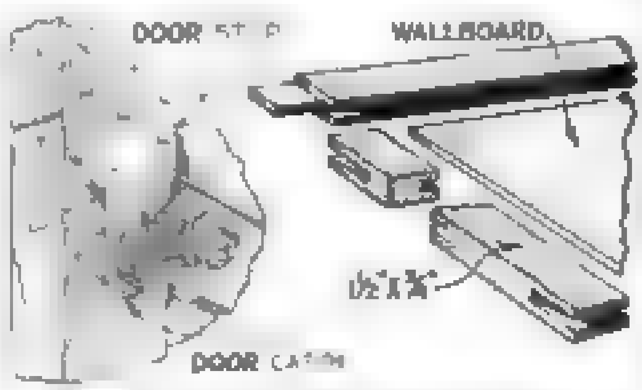
SOME indication of what can be done by the home worker in remodeling and reclaiming old furniture is given by the accompanying illustrations.

In this instance a wardrobe was needed badly and an old kitchen "safe," which had been relegated to the cellar long before, was made to serve. The old doors were taken off and new frames of $\frac{3}{4}$ by 1¼ in. stock were grooved to take panels of fiber wallboard. The joints at the corners were mortised

This neat, well finished wardrobe does not betray its origin in an old kitchen cupboard

and tenoned and each was fastened with glue and two screws.

The top spring latch and catch were made of heavy sheet iron, as detailed, and a hook and screweye were used at the bottom. The hardware is of brass—butt hinges, trunk-lock, drawer pulls, and casters. Brass hooks for the coat hangers were screwed into the top and two brass



Details showing the method of making the new doors and the homemade door catch

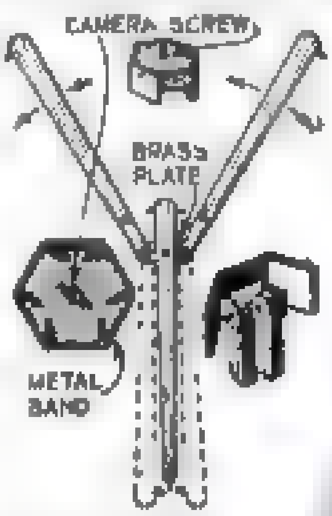
telescopic curtain rods with eyes at the ends were bent and screwed in place for trousers hangers. The perforated ends of the case were replaced with wallboard

(Continued on page 117)

Tripod for Hand Camera Made from Hardwood Strips

AMATEUR photographers who wish occasionally to use a tripod can make one at a trifling cost. Maple or any strong wood may be used. Six pieces ¾ in. square and 27 in. long, with the corners slightly rounded, are required, as well as three pieces 30 in. long. The latter are tapered and fitted with a brass cane ferrule and a headless spike in the end that is to grip the ground.

A slot is cut through each of these 30-in. sticks 4 in. from the upper end to take a brass plate ½ by 1¾ in. Slots also are



The completed tripod, and diagrams revealing the simple construction of the joints and of the cap piece

cut in the lower ends of the 27-in. pieces, [illegible] then [illegible] by means of a brass plate [illegible] forming a hinged joint. A stud or wooden pin is inserted through the [illegible] of each of the lower legs and engages corresponding holes in the upper pieces when the tripod is set up.

The tripod cap is a hexagonal block 1 in. thick with sides measuring 1¾ in. It is covered with a piece of galvanized iron bent as shown and drilled to receive the six pins that are used to fasten the legs to the cap. A nut is set into the wood on the under side of the cap to take a [illegible] stove bolt, which will screw into the tapped hole to be found in a kodak.—MRS. RUTH D. SHULTIS

Commodious Clothes Locker

(Continued from page [illegible])

After the old finish had been removed and all the wooden surfaces had been well sanded, the locker was given a coat of flat black. Then the cracks and holes were puttied and a final coat of flat black completed the work.

As old kitchen safes of this type often were made of a good grade of oak, a piece remodeled in this way usually may be finished with stain, filler, and from two to four coats of flat varnish, if preferred. It also might be finished with tinted enamel or wood lacquer. Some such old pieces, indeed, could be made into excellent china cabinets if sufficient pains were taken with the remodeling and refinishing.

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

PLASTER of Paris, which has many uses in the home workshop, may be hardened and toughened by mixing it with a diluted glue solution instead of water. The mixture also sets more slowly, which is sometimes an advantage.

Plaster casts can be made more or less weatherproof by painting with three or four coats of linseed oil, each coat being allowed to dry before the next is applied. Small casts can be placed for an hour or two in a pan of linseed oil, the oil being heated to just below the boiling point.

Plaster also may be colored. The pigments used are the salts of the metals, lead, copper, and iron, either alone or in combination. The plaster is mixed very thoroughly with a watery solution of the salt, and then a little formaldehyde is added to fix the color. A preliminary experiment on a small scale should be made first to determine the proportion of salts needed to color the plaster to the right shade and with the desired intensity.

If you never have experimented with plaster and wish to learn what interesting

Hardening a plaster-of-Paris cast of the foot of "Lagopus," an Alpine ptarmigan

things can be done with it, get some plaster wax, such as is sold for children's use in toy stores, and model a medallion with your initials or any design you please.

Color a small quantity of water with a trace of bluing and sprinkle plaster of Paris into it until it is the consistency of thin cream. Pour this over the wax to make a thin layer and, when it sets, brush soapy water over it. Then mix uncolored plaster and pour it over the colored layer until the mold is ½ in. thick or more.

After the mold is hard, turn it over, pick out the wax, give the inside a coat of soapy water, and pour plaster into it. Insert a loop of wire in the plaster to provide means for hanging the finished plaque.

When the plaster has hardened thoroughly, split off the mold with an old chisel or screwdriver down as far as the blue layer and then proceed very cautiously to chip off the colored coating. This will expose the surface of the plaster medallion, which will be a perfect reproduction of the original wax.

The plaster may be bronzed and then toned with brown, green, and blue artist's oil colors put on in dabs, blended, and partly rubbed off.— ERNEST HAHN, Ph.D.

The Home Workshop

How to Frame a Dormer

(Continued from page 74)

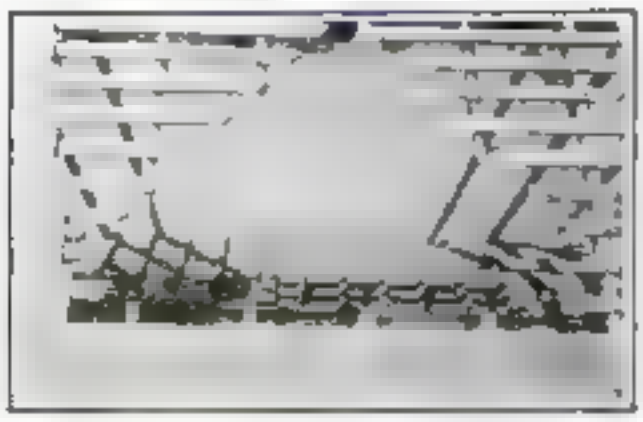


Fig. 2. The first step is to remove the shingles and cut out the rafters and sheathing

and nails driven into the edges with the points or the edges of the heads inclined downward act as claws to grasp the roof

Pull all shingle nails from the sheathing to avoid touching them with the saw Two inches outside the wall line, saw off, with a vertical cut, all rafters on the width of the gable. The top of the lower window trimmer (Fig. 4) is 2 in. above this height, and the bottom of the upper trimmer is 2 ft. 5 in. above the lower trimmer, so that, allowing a 2-in notch in the rafter where it meets the side trimmer, the upper side of the rafter is 2 ft. 11 in. above the line of cutting of the main roof rafters. This allows for windows 2 ft. high

The dormer plates notch into the rafters 1 in., rising 18 in. from the base. Therefore, the sheathing must be cut (as in Fig. 2) at right angles with the base line to a point 18 in. above it, where the valley cuts obliquely to the ridge point of the dormer

The general construction of the dormer end of the room is shown in Fig 4. The side wall plates bear against the under edges of the rafters, as they do in the plain wall described in the second article of the series last month; but the regular studs—that is, those spaced 16 in. from

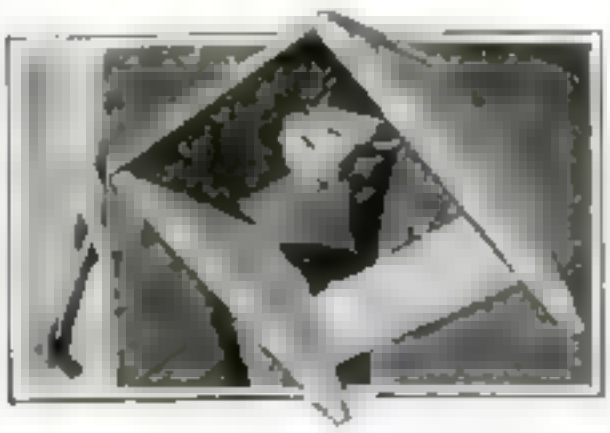


Fig. 3. A roof jack is of great assistance in working on a shingled roof

center to center—rise to the dormer plate as at *A*, Fig. 4, and the side trimmers (*B*), to insure rigidity, rise from the floor plates regardless of their position between the regular studs. They are notched around the rafters, as shown in Fig. 3

Figuring for a mullion frame for 2-ft. casement windows, with a 4-in. mullion, the side trimmers should be 4 ft. 7 in. apart

Figures 5 to 11 illustrate the method of

(Continued on page 120)

How to Frame a Dormer

(Continued from page 119)

laying out the rafters. The projection of the roof beyond the side plates should equal that of the main roof. Lay out the top cut as in Fig. 5, using 12 in. on the blade and 9 in. (or whatever value the rise per foot may be) on the tongue of your steel square, and step along the stick with this hypotenuse as many times as there are feet in half the width of the dormer (See Fig. 11). Lay out for the

Fig. 5. Laying out the top cut on one of the two dormer rafters with a steel square

plate notch 1 in. deep, and give the necessary foot projection. Cut the rafter and use it as a pattern for its mate

Tack the two together at top, rest the notches on the plates, and scribe for the trimmer notches. These cut, nail the rafters in place, level to the main roof for the ridge point, and saw off the sheathing with vertical cuts, as in Fig. 2, afterward cutting off the rafters as well with vertical cuts 1 in. back from the sheathing so that the latter will have a bearing on the valley rafter.

Valley rafters are laid out like common rafters, except that 17 is substituted for 12 on the blade of the square, since valleys make angles of 45 degrees with the walls and, therefore, must be longer The ends where they meet with each

Fig. 6. Above: Marking the foot [illegible] rafter Fig. 7 (right) Below the cut end of rafter appears

other, or with rafters or headers, are cut like jack-rafter feet, using 17 for the 12 Nail the valley rafters in place and nail down the loose sheathing ends.

Plumb the gable rafters and measure 2 ft. from them to the valleys, parallel with the plates, to locate the jack rafters, which successively diminish in

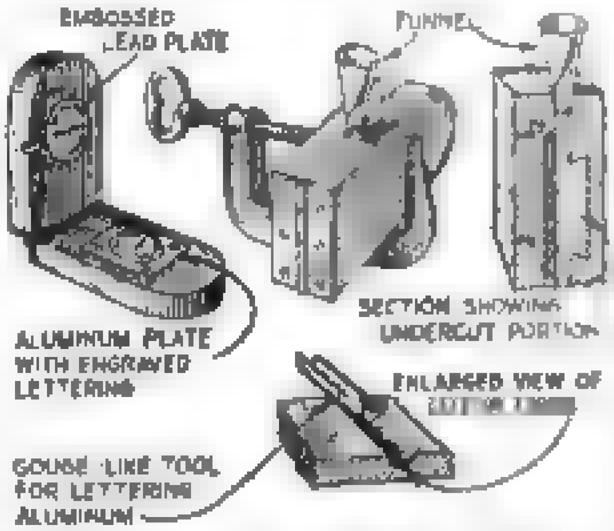
(Continued on page 121)

The Home Workshop

Simple Embosser for Stamping Your Initials on Paper

AN EMBOSSER for stamping your initials or other lettering on paper may be made from materials available in almost any home workshop.

Two ½-in. blocks of pine are hinged together as shown. On a thin plate of aluminum the initial or other lettering is marked out carefully and then engraved by means of any sharp tool such as a miniature gouge made from an umbrella rib or even the point of a sharp knife. A free and informal style of letter will give better results than one that is stiffly mechanical. However, a machine-stamped name plate can be used if preferred.



The embosser is made by cutting an aluminum die and molding a corresponding lead punch

The finished plate is inserted in a suitable countersunk space in one of the blocks and held with screws. The block opposite is chiseled out and undercut as shown and a small opening is made to permit molten lead to be poured into the block after the pair has been fastened tightly together with a clamp.

After the lead has cooled and been trimmed where necessary, it will be found that a faithful reproduction of the original engraving can be obtained by inserting a sheet of paper between the blocks and striking the upper one a sharp blow.—L. K. WRIGHT

Photographic Print-Washer Cheaply Built of Wood

By J. G. Pratt

Scientific Photographer, U. S. Department of Agriculture

THE homemade photographic print-washer illustrated not only is easy to make at little or no cost, but it works on scientific principles and is as efficient as expensive commercial washers.

It can be made any size to fit one's sink and to accommodate the volume of work required The one shown is 24 in. long, 17 in. wide, and 6 in. deep—merely a large, shallow box put together with brass screws or galvanized nails.

Boards are mitered to fit across the corners, as indicated The water comes in at one corner through a hose from the faucet. The corner boards give the water a circular movement, which, even at very low pressure, is sufficient to keep all the prints in motion

The outlet is cut in the farther end of the fourth corner board, so that as the

The prints are kept in motion and washed thoroughly by the circulation of the water

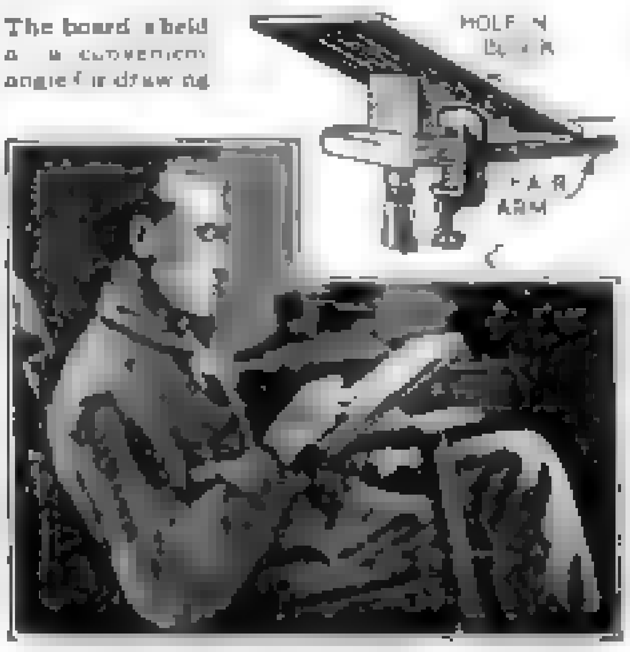
water passes around there will be no tendency for the prints to be sucked into the outlet In order to show clearly the general scheme of circulation, however, this opening is indicated on the photograph as in the near corner

Being low down, the outlet soon clears the tank of hypo, which settles to the bottom. An outlet is cut in the outside of the tank to allow the overflow to drain into the sink This outlet should be large enough to take care of the water at considerable pressure and placed so as to water from rising higher than

Triangular Block on Chair Arm Supports Drawing-Board

A SMALL drawing-board may be supported on the arm of a chair in a convenient position for either writing or sketching by the use of a triangular block clamped to the arm, as shown. The

The board is held at a convenient angle for drawing

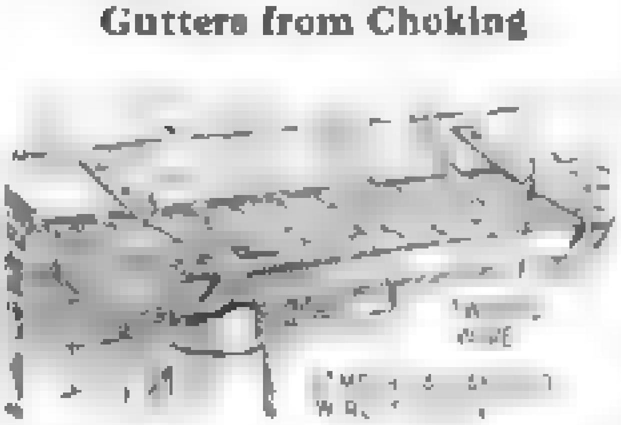


wedge-shaped block is cut from a "two by four." A hole is bored in one side to receive the upper arm of a C-clamp. The drawing-board may be fastened permanently to the block or merely rested against it.—CLYDE E. VOLKERS.

Repairing Pails that Leak

IN NEARLY all cases the bottom of a leaky water pail rusts out while the sides are nearly as good as new. Instead of soldering over the holes, cut a new bottom from a sheet of galvanized iron and drop it in place over the old bottom. Tilt the pail slightly and use a hot iron to solder around the joint. This makes a neat and permanent repair.—J. J. B.

Strips of Wire Mesh Prevent Gutters from Choking



THE choking of gutters often results in an overflow of water that wets the walls and sometimes damages the wall paper inside a house. A practical method to prevent the eaves trough from filling and clogging is illustrated above. Strips of ½-in. mesh galvanized wire are placed in the upper part of the trough, flush with the top, and fastened with twisted wires to the gutter fasteners.

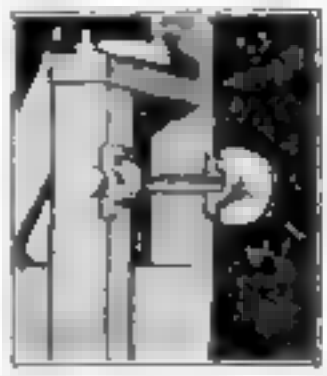
The leaves and trash washed down the roof are caught on the screen and afterward dry out and blow away. In locations where cleaning the trough is difficult and somewhat risky work, the provision of guards of this kind is particularly advantageous.

The Home Workshop

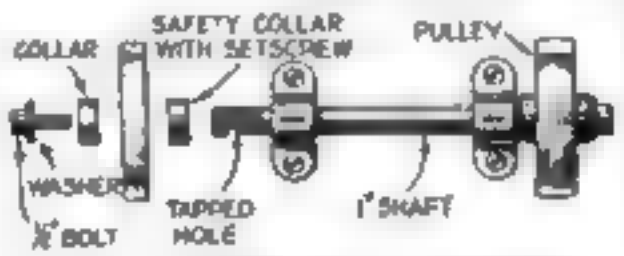
Ordinary Bolt Used to Hold Emery Wheel on Arbor

A LATHE or a set of large size threading dies is not essential for making an emery-wheel arbor like that illustrated or, indeed, any light spindle to which a circular saw, buffing wheel, pulley, gear, or sprocket is to be clamped.

The arbor need be nothing more than a piece of shafting of the right size for the bearings that are to be used. A hole is tapped in each end to take a bolt, which, in the example illustrated, is ¼ in. in diameter.



A safety collar is slipped on one end and fastened. Next to it is placed the emery wheel, pulley, or whatever part is to be used. This is followed by a collar or a number of washers to extend just beyond the end of the shaft. The bolt with this washer then is screwed into the tapped hole until the wheel is clamped tightly. The same method may be used for attaching a pulley to the opposite end of the arbor.—J. B.



An exceptionally simple method of fastening wheels, pulleys, and gears to small shafts

How to Finish Cedar Chests

TO MAKE a good cedar chest one must know how not to finish it. Recently an amateur craftsman friend showed me a chest upon which he had spared no pains or expense, but it had been spoiled by the application of several coats of hand-rubbed varnish, both outside and inside. This practically killed the cedar aroma.

The inside of cedar chests and the aromatic cedar linings of closets should receive no finish at all. If the surface has any objectionable features or the joinery needs concealment, cover the inside with some light fabric fastened with tacks. The outside can be finished with two coats of white shellac applied evenly and thinly, each coat rubbed down with burlap or curled hair.—A. J. H.

Spring Clamp for Glued Joints

SINGLE turns of spring wire cut from an ordinary bedspring make fine clamps for holding together small glued joints, such as at the corners of picture-frames. One complete coil of the desired diameter is cut from the spring and sharpened at both ends.—M. E. S.

Better Shop Methods

(Continued from page 2)

Old Bill Says—

GOOD work depends more upon the skill of the mechanic than it does upon the kind of tools available.

Try to select a tool and a method appropriate for the job in hand; using fine, delicate machinery and light tools for rough work is never good practice.

Old Bill, machine-shop foreman

Some men use a micrometer as if it were intended for a clamp. My sympathy is with the "mike."

Make use of every safety device provided in the shop.

If you have any grouches, leave them at home; the shop is no place for them.

It is better to take plenty of time in grinding a milling cutter than to hurry the job and perhaps spoil the cutter by burning it.

Fine, hard wheels or heavy cuts are what burn a cutter; very light cuts should be taken and as many cuts as are necessary to clean up all around.

If you think you lack new and better opportunities, the chances are you will miss the one you have right now.

Keep your eyes open and you won't need to ask: "Where's this?" and "Where's that?"

A man can be pulled out of a rut, but he must run on his own power after he is out.

Easily Detached Stud Driver

A STUD driver that can be detached easily from the stud after it is driven home, or after the stud has been removed from the hole, is illustrated. It is made of hexagon steel of about the size of the nut. A slot is cut at the end of the tapped hole to take a tapered key, similar to a drift for removing taper shank drills.

Driving a stud

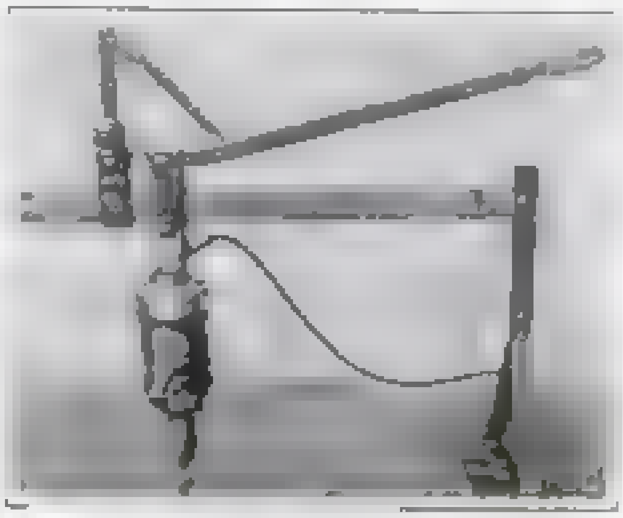
With the key in place the driver is turned on the stud and the stud is driven home. Then the key is knocked out so that the driver is free to turn off loosely.—R. W. CADMAN

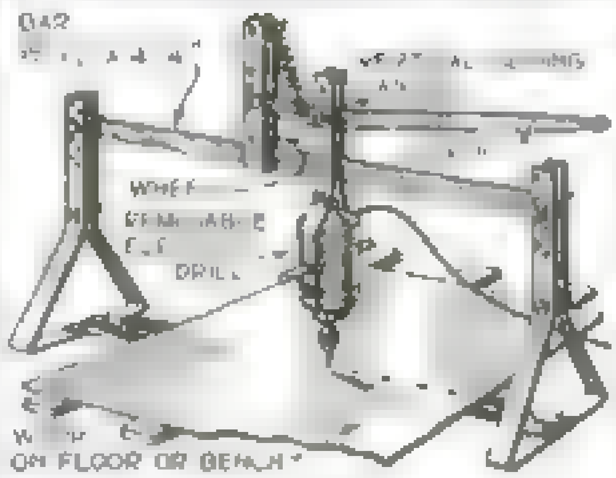
Simply Constructed Frame Aids in Drilling Large Plates

TO ADAPT a portable electric drill for drilling a number of plates with holes 20 in. from the edge, I made a supporting frame as shown below. It would have been exhausting work to have drilled the holes without some support for the drill.

The frame is constructed entirely of flat bar iron, each piece ½ by 2 in. by 4 ft. 4 in. The brackets are drilled with a series of holes for adjusting the height of the horizontal bar.

The sliding bracket also has holes to allow additional vertical adjustment





How a portable electric drill is supported for drilling holes in large and awkward work

A coilspring attached to the sliding bracket and the drill lever in either of the two ways illustrated is of some assistance, as it holds the drill away from the work, except when pressure is applied on the lever.

The hanger for the drill may be made from a single piece of iron bent as shown in the photograph, or of two pieces as indicated in the drawing, depending upon the type of drill that is being used.

The sliding bracket is provided with a steel roller so that it is easy to shift the position of the drill in a horizontal plane.

The general dimensions of the frame may be modified to suit the type of work to be done.—O. W. MIELENZ.

FOR getting oil into the several oil holes on a lathe that are at an angle and difficult to reach, I use a high-pressure oil gun with a nozzle to fit the holes. Work that cannot be held in a universal chuck, and, because of a flange or projections, is difficult to set up in a four-jawed chuck so the center will run true, can be adjusted easily by truing the outsides of the jaws, provided they are all of the same length.—G. T. S.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

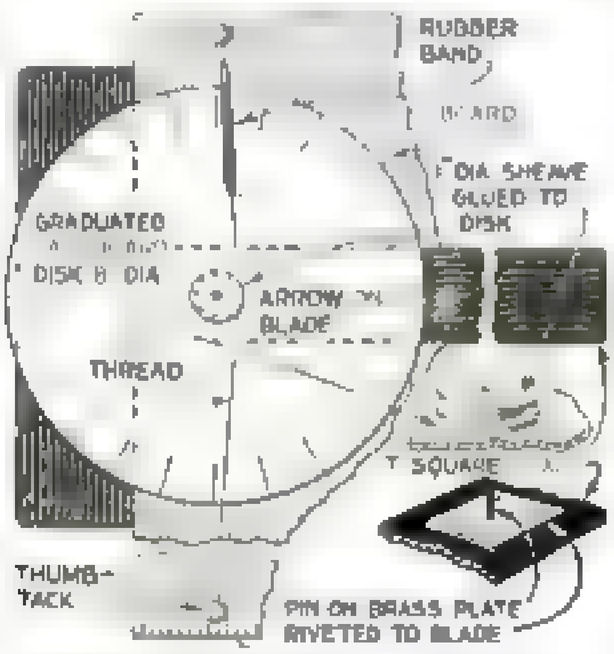
Semi-Automatic Guide for Ruling Parallel Lines

HERE is an easily made device for ruling a large number of parallel lines at equal distances from each other with almost machine-like accuracy. It consists of an 8-in. disk with a 1-in. sheave attached to its center, the disk being pivoted on a blade of a T-square.

A cord or thread stretched between pins at the top and bottom of a drawing-

Ruling lines on a special form by means of a quickly improvised spacing device

board is fastened around the sheave, so that a downward movement is transmitted to the T-square by rotating the disk. An arrow is marked on the T-square as an index point. Two lines the desired distance apart then are marked on the drawing paper, and, by moving the T-square from one to the other and simultaneously marking two points on the disk, it is determined how far apart the divisions on the disk must be. These



Turning the disk from one mark to another moves the T-square down one space

then are stepped off around the circumference of the disk.

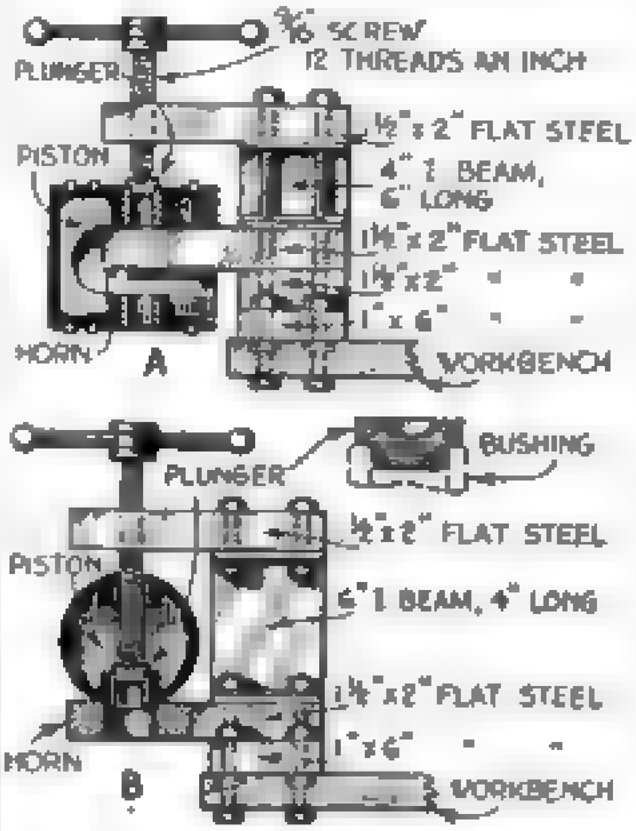
Any number of sheets can be ruled rapidly thereafter by moving the left-hand edge of the disk downward with a finger of the left hand the distance of one graduation after each line is drawn. Several interchangeable disks having different graduations may be provided.

ONE of the best lubricants for lathe centers is a compound of white lead and machine oil, mixed to a consistency of a thick paste. It lasts longer than oil.

Jigs for Speedily Replacing Wristpin Bushings

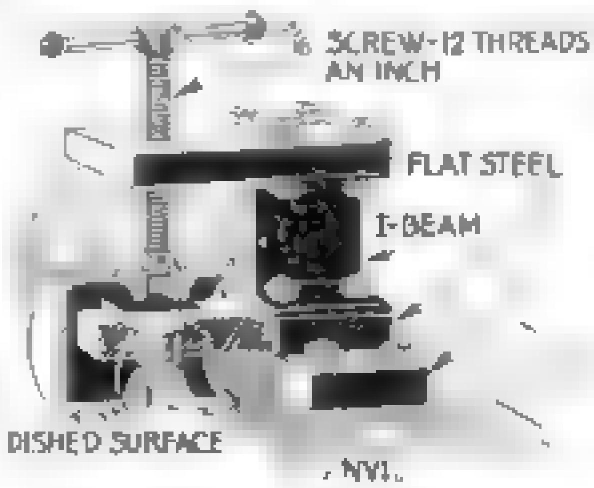
GARAGE owners or mechanics who are anxious to cut down the time required to replace worn wristpin bushings will find that the two jigs illustrated are big time-savers. They are easy to construct, made from materials readily available, and will prevent the breakage of pistons.

At *A* is shown the arrangement used for forcing the new bushing into the piston, and at *B* is the other jig for pressing the old bushing out of the piston, which is done from the inside



New wristpin bushings are pressed in as at *A*, and old ones removed as at *B*

The horn for jig *A* is flat, and small enough to go into the smallest piston, while the horn for jig *B* is slightly dished to prevent the piston from slipping when the pressure is applied. A plunger will have to be made for each size bushing, although the same plunger can be used for pressing bushings out and putting the



A suggestion for combining the two jigs, if it is desired to save space

new ones in. They should be made a trifle smaller in both diameters than the bushings.

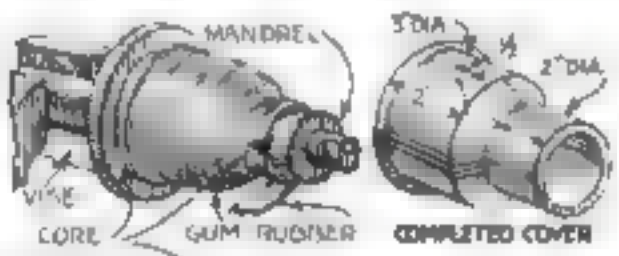
While the screw is shown as 12 threads to the inch in each case, it may be coarser or finer to suit shop conditions. To save space, the jigs can be combined if thought advisable into a double-purpose device. —FRANK N. COAKLEY.

Rubber Dust-Covers Produced in a Machine-Shop

RUBBER articles rarely are produced in a machine-shop, but they can be made, if of a simple nature, with ordinary equipment. In one instance a shop building grinding-machines required a cover to keep water, dust, and dirt from a bearing near the end of the spindle.

Leather was tried without much success and it was decided to use rubber. It was found that a neat and satisfactory job could be done. The stunt was another demonstration of how machine-shops can "roll their own" in emergencies.

A mold and core of cast iron were made as shown and bolted together. The bolt hole through the central core was reamed to be a snug fit on a standard mandrel. Where the core comes in contact with the mold at each end the diameter of the core is about .003 in. smaller than that of the



To produce the rubber dust cover shown above, an iron core is wrapped with rubber strips a mold is pressed over it and the whole is heated in a furnace

mold so that the two pieces go together and come apart freely.

The material used is ordinary gum-rubber repair sheets 1/16 in. thick and 12 in. square, which are sold by auto-supply houses for repairing tires and tubes. This is cut into strips about ½ in. wide. The core and mold are dusted with powdered soapstone and the core is placed on a mandrel in a bench vise. The rubber is wrapped around it, starting from the large end. Two layers are put on as evenly as possible.

Some experimenting was necessary at first to get the right amount of rubber to fill the mold evenly. The material used in each test was weighed on a small postal scale. The third piece came out perfect in shape and of uniform thickness, and it then was easy to duplicate the result by weighing the material each time.

When the rubber is built up in the rough, the mold is forced over the core. The core and mold then are removed from the mandrel, bolted together, placed in a furnace, and held at a temperature of 400 deg. for about 20 minutes. They are then removed and cooled in an air blast. Water cannot be used for cooling as it makes the rubber porous. When cool, the core is pressed out, leaving the dust cover in the mold, from which it can be removed by hand.—H. L. W.

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Better Shop Methods

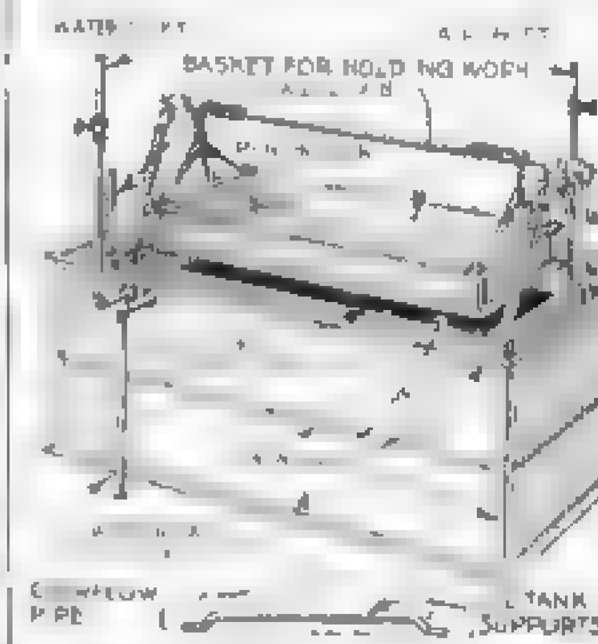
Oil Quenching Bath for High Speed Steel

By H. L. Wheeler

THE oil quenching bath illustrated below is large enough to serve two furnaces on manufacturing work such as the making of milling cutters, drills, reamers, and other tools. The outer or water tank is 3 by 3 by 8 ft. It is made of heavy galvanized iron reinforced by ¼-in. angle irons at the corners and around the top and bottom.

The inner tank for the oil is 2 ft. 6 in. by 2 ft. 6 in. by 6 ft. and is of similar construction. It is supported by three pieces of iron, bent as shown and fastened to the bottom of the water tank.

For holding the work a basket is made of perforated metal reinforced with angle



The oil, which is in a water jacketed tank, is kept agitated by compressed air

iron and provided with a simple type of lifting apparatus. The brackets that support the shaft are made of ½-in. flat iron and are bolted to the top of the oil tank.

The shaft rotates in two cast-iron pedestal bearings, which are bolted to the brackets. At one end is a ratchet wheel and pawl to hold the basket suspended while the work is being removed. Two pieces of chain of equal length are fastened to the shaft and connect it with the work basket.

The outer tank is piped to a water main and is connected with a drain. Both inlet and outlet are provided with valves. An air pipe connecting with a compressed-air line enters the oil tank at one end and runs diagonally along the bottom. A series of holes drilled along the underneath side of this pipe allows the air to escape for the purpose of keeping the oil agitated so that the bath will remain as nearly uniform in temperature throughout as possible.

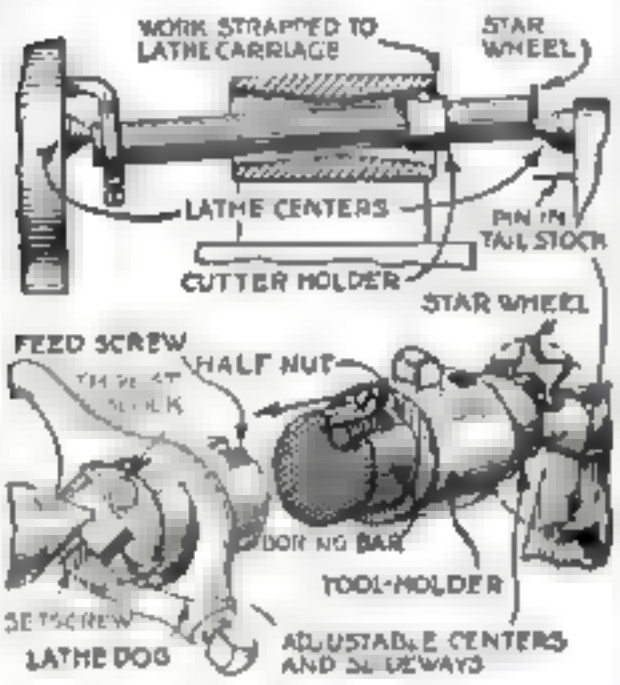
A length of 2-in. pipe is set into the water tank at one corner and serves as a receptacle for the cold end of the pyrometer.

When the work begins, the basket is immersed in the oil so that the top is covered. Both the water and air are turned on and the tools, as they are taken from the furnace, are plunged into the oil.

Eccentric Bar Used in Boring Two Tapers at Once

BORING a large shaft coupling with a taper in both ends was accomplished in one shop by departing from the usual method of holding the casting in a chuck. Instead, it was strapped to the carriage of the lathe and the boring was done with a bar, both tapers being cut at the same setting. This insured accurate alinement.

Slots were cut in each end of the shop's sliding-head boring-bar so that an adjustable center could be held with a set-screw in order to provide a center hole eccentric to the axis of the bar. Each end



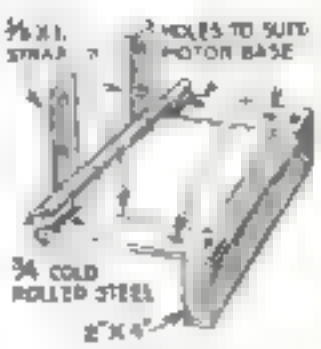
Two tapered holes in exact alinement are cut by the tool as it advances through the casting

of the bar was set the same distance off center, but in opposite directions. One point in the middle ran true, and this located the position of the center of the casting. A pin set in the tailstock actuated the star wheel on the end of the feed screw, which engaged a half nut in the boring-head

The tool was traversed from one end of the casting to the other, and, owing to the eccentricity of the bar, it bored a hole progressively smaller until it reached the center of the casting, where the taper reversed, and the tool, continuing to cut, made a hole that became uniformly larger —J. A. HORTON

Hinged Bracket Holds Motor of Small Drill Press

A MOTOR for driving a small drill press can be mounted easily and cheaply on a hinged bracket made as illustrated. This is fastened to the pedestal of the machine so that the motor is well off the floor, where it is out of the way and less liable to become dirty. A mounting of this type has the additional advantage of keeping an even tension on the drive belt at all times.



A motor bracket for a drill press

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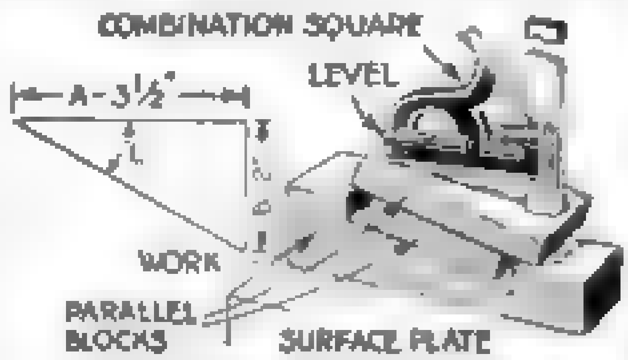
How to Use a Combination Square as a Protractor

IN THE absence of a protractor, the combination square may be used to measure an angle by the application of simple trigonometry.

With the work to be measured on a level surface plate, the scale is adjusted in the head of the square until the bubble is in the center of the glass. Then we have two sides of a right-angle triangle.

Assume that, as in the illustration, the distance *A* from the scale to the edge of



Measuring an angle with a combination square and a little elementary shop trig.

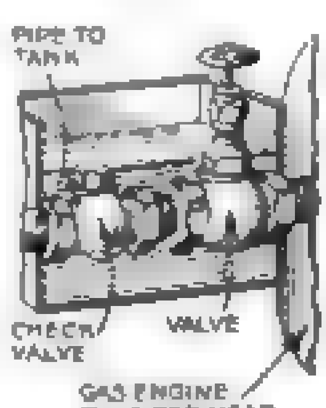
the head is 3½ in. and that *B*, the projection of the scale through the head, is 2 in. Then the tangent of the angle *L* is 2 divided by 3½ or .5714. Referring to a table of trigonometrical functions we find that the angle corresponding to that tangent is 29 deg. 45 min. The distance *A* always will be constant with a given square head, while *B* will vary with the angle.

In the example shown in the drawing, it was necessary to use two parallel blocks to bring the angle up, as the space was not large enough to use the square head directly.—HUGO LJUNGQUIST.

Gas Engine Supplies Shop with Compressed Air

COMPRESSED air, when required in small quantities in a shop, may be obtained from a gas engine, if one is used and if the air does not have to be pure and unburned.

Two nipples, a cut-off valve, and a check valve are the essential parts. Drill a hole in the cylinder head, tap it for a ¼-in. pipe, insert a ¼-in. nipple, and screw on the cut-off valve, another nipple, and then the check valve. Next come the connections to the tank, if one is used, or a pipe of large diameter tightly fitted, which will serve as a small reservoir.



Valves connecting cylinder with air line

If more than a small quantity of air is to be used, it might be well to fit a small water reservoir around the cut-off and check valves, as illustrated, to prevent overheating. That is essential only when the air is used quite steadily. Pressure in the neighborhood of 100 pounds usually may be obtained in this way.—HIRAM E. BARBER.

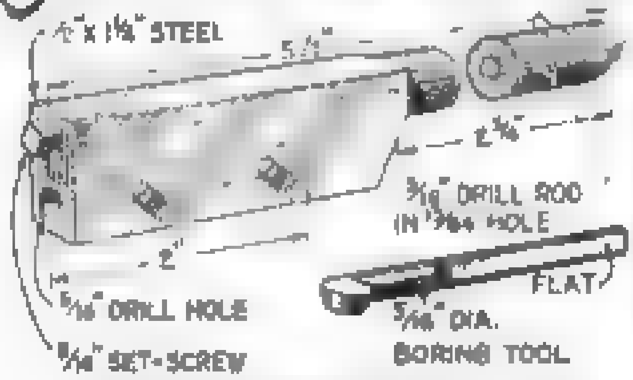
SEE—the big Prize Offer on page 144 of this issue.

Better Shop Methods

Combination Boring-Tool Holder Is Useful for Awkward Work

SEVERAL improvements over the usual type of boring-tool holder ordinarily made by mechanics for their own use are to be found in the tool illustrated.

The common method of locking the toolbit is to have a setscrew in the tool end of the bar, either at the side or the end. This screw sometimes interferes with the work to such an extent that a forged tool is required, especially in very small holes or in holes with a blind end. In this holder, the locking device has been placed at the rear. This is accomplished by drilling a hole longitudinally through the body of the tool and using a



Two types of boring tools can be held in this unusually simple and convenient holder

short length of steel rod to transmit the pressure from the setscrew to the toolbit.

Another feature of the tool-holder is the provision made for holding a second tool of smaller size made from drill rod. This tool, which is made as needed, has a flat ground on one side to prevent its turning in the holder and is locked by two setscrews.

The body of the tool is a solid piece of 1/2 by 1 1/4 in. tool steel, 5 1/2 in. long, from which a section 3/4 by 2 3/4 in. is cut with a hack-saw or in a milling machine. The barrel then is finished in a lathe as shown above.

Tools of the same design can be made in larger sizes when required for heavier work.—C. G. Kreig

Handy Milling Fixture

THIS fixture is designed for use on hand-milling machines for holding small shafts and other round work. It saves time on many operations, such as milling keyways, slotting and milling shafts, and similar work.

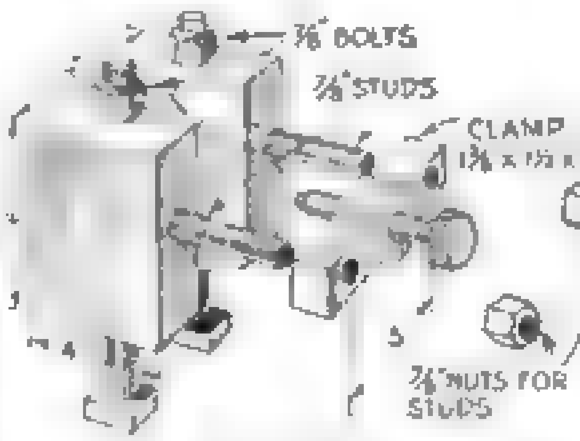
The iron body of the fixture is cast from a simple pattern. A solid key is planed on the bottom to fit the table slots; this should be parallel with the V. The clamping piece is cast with a cored hole and is made a sliding fit in the guide hole. The screw has a square end to take either a wrench or a regular vise handle.—H. L.


Fixture for holding small shafts on a milling machine

Better Shop Methods

A Ruggedly Built V-Block for the Drill Press

DRILLING holes in the ends of pins or bushings is expedited by having a heavy V-block similar to the one illustrated. It is designed to be bolted to the drill-press table, and may be made of steel or cast iron. The screw in the clamp is of value in clamping work smaller than the depth of the V.—H. M. CORNWELL.



Details of a heavy V-block for handling a wide range of cylindrical parts

Shop Racks and Tables

(Continued from page 23)

"We can get in the habit of keeping the tools where they belong. I can get some boards built behind the lathes to hold the chucks and collets. We can make some sort of benches to go by each drill press, so that we can keep the V-blocks and angle irons off the floor."

"You could paint numbers on the machines," Mr. Jackson suggested, "and number the tools that belong to each machine, so that even a new man will have no trouble in putting things back where they belong."

The foreman nodded approval.

"KEEPING taps and the drills that go with them together in a block is a mighty good plan, I think," Black said. "Now in this job that I fell down on I had to go one place to find a tap and another to find the drills to use. I know that we have a counterbore for a one-quarter-inch screw head, but I could not find it this morning. If they were all kept together, it would save a lot of time."

Out of the distance came the far-away sound of a factory whistle. Soon the shop's whistle would blow likewise. The group rose to go into the shop, every man with a fuller understanding of what is one of the main problems of management—having things where they ought to be when they are needed; and each had a keener appreciation of the part he must play in the game of getting the shop work out on time and in good shape—a really fascinating game to those who play it right.

Getting Ahead?

Read the advertisements on Pages 144 to 174 this issue if you want to get ahead!

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Simple Fixture Saves Time in Drilling Holes Accurately

DETERMINED to reduce the time required to drill holes accurately by the button method, one shop developed the tools shown in Fig. 1. Their application is illustrated in Fig. 2.

The steel block has a hole at one end to take a plug with an accurate center, or any one of several drill bushings. In drilling a die or jig plate, the holes are laid off on

Fig. 1. The drilling block, the plug used for locating it, and one of the drill bushings

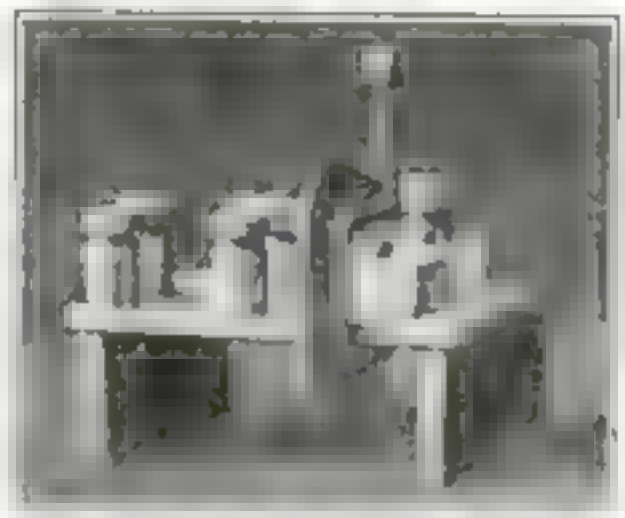


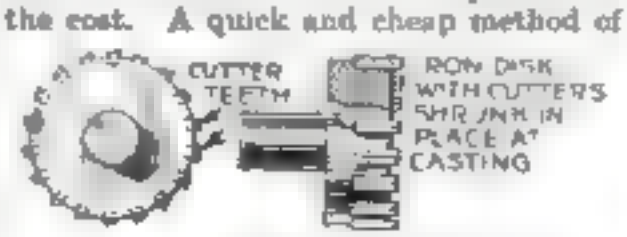
Fig. 2. After the block has been located properly a suitable drill bushing is inserted

the plate with the aid of a height gage and carefully center punched. The marks may be checked with a magnifying-glass for very accurate work.

The block is placed on the plate with the hole over one of the center punch marks. The pointed plug is put in the hole so that the point is in the center mark. While in this position the block is clamped rigidly. The plug then is removed and a bushing is inserted to guide the drill that is to be used.—C. K.

Cheaply Made Milling Cutter Has Teeth Cast in Head

SMALL shop owners and foremen often hesitate to make a new milling cutter because of the time required and the cost. A quick and cheap method of



Steel cutters are placed in the core prints in the mold before the head is cast

making a good cutter without the usual difficult machine work is illustrated.

A plain disk pattern of the size required is made for the head. Core prints of a size to suit the cutters to be used are located around the circumference of the pattern. When the head has been rammed up in the sand, the self-hardening steel cutters are placed in the core prints in the mold, just as a core would be placed in regular work.

It is advisable to dip the cutters in oil before inserting them in the mold. That is done to clean off all dust and to insure the iron's adhering to the cutters.

The casting is removed from the sand as soon as possible after the iron has been poured and allowed to cool in the air. The iron shrinks around the cutters, holding them very securely.

This process softens the self hardening steel to a small extent, but no difficulty will be found in heating the cutters in the ordinary way and cooling in an air blast to bring back the needed degree of hardening.

The cutter head is machined to suit the arbor and the cutters are ground to the required shape.—F. C.

Steel Ball and Setscrew Hold Tool in Boring-Bar

IN SEEKING a simple method of holding a tool in a boring-bar, one small shop finally settled upon the design illustrated. A hole is drilled diagonally at an angle of 45 degrees to intersect the hole that is to contain the boring-tool. This hole is tapped to take a setscrew. The cup point of the setscrew bears against a steel ball, which in turn presses against the boring-tool. Tightening the screw does not tend to move the tool as is the case when only a setscrew is used. Care is necessary to avoid losing the ball when tools are changed.—G. L.

Section showing the end of a boring bar

Soldering Overhead Wires

FOR soldering ordinary "pigtail" joints in open house wiring and in various types of overhead wiring, especially in awkward places, it often is possible to speed up the work by making a crucible for melted solder out of an ordinary 1¼- or 2-in. gas-pipe cap or collar as shown. If a collar is used, it is plugged at one end. Two ¼-in. holes are drilled opposite each other about ¾ in. from the top, but they should not go quite through the collar or cap. A handle about 2 ft. long is made of wire.

After all the joints are clean and coated with flux, solder is carried from joint to joint.—C. B.

A crucible for solder

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The Shipshape Home

Shortcuts in Hanging Cupboard Doors

IN KEEPING a house shipshape it frequently is necessary to build cupboards, to fit doors in front of shelving, or to do other work that involves the use of hinges.

Most home workers, so far as I have observed, are familiar with the ordinary surface hinge, which requires no especial skill to attach, and the butt hinge, which calls for considerable accuracy and some little experience to fit properly, but they do not know the advantages of what is called the "half-surface" or "half-mortise" hinge. It can be used in many cases where a surface hinge will not do, and at the same time is much easier to attach than a regular butt hinge. Altogether, it is an invaluable type of hinge for use around the house.

The first step is to chisel a recess in the hanging stile for the butt or mortise leaf of the hinge. It should be cut accurately and of uniform depth, so that the surface of the leaf will be flush with the stile or jamb.

When a pair of hinges or three for a large door have been fastened in this way, the door is put in place and held, if necessary, with wedges. The surface leaves of the hinges then are screwed to it. Obviously, much less time is required for this than in fitting a regular butt, and there is no chance of the door's binding, sagging, or giving other trouble.

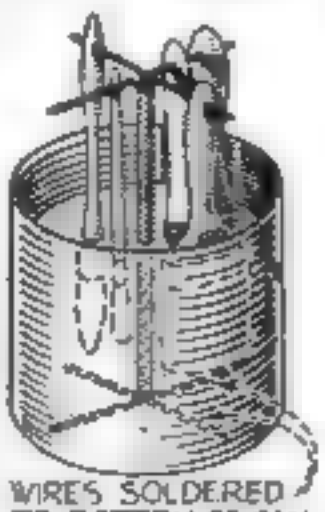
Full surface or "butterfly wing" hinges are applied merely by screwing them on after the door has been wedged in place as tightly against the hanging stile as possible. Unless of special design, they cannot be used when the hanging stile is narrow or molded or not flush with the surface of the door. On furniture they are apt to look rather crude and clumsy. Provided the appearance is not a matter of importance, a narrow butt hinge usually can be applied as a surface hinge when a regular butterfly hinge would be too wide.—RUFUS E. DEERING.

Marking the location of the mortise for a half surface hinge

Screwing the one visible hinge leaf to the door

Three types of door hinges—butt surface and half-surface

Paint-Brush Rack



Hanger for brushes

MY METHOD of supporting brushes in a can of turpentine when not in use is to hang them on a rack made of wire as shown. The wires are twisted together and soldered except at the ends, which are bent out radially. The lower arms may be soldered to the inside bottom of the can although it is not essential; the upper arms support the brushes Holes are drilled in the brush handles at the correct height to allow the bristles to be completely covered by the liquid, so that they are in good condition when needed again for work.—W. L. WHEELWRIGHT

Polishing Windows

AFTER washing windows, I give them a brilliant polish by applying a mixture consisting of 4 tablespoons each of household ammonia, grain alcohol, and pulverized whiting in 1 qt. of water The liquid is allowed to dry on the glass and the window then is given a final polishing

This polishing treatment is reserved for the outside, as the windows inside require only a light rubbing with a chamois skin wrung out in warm water

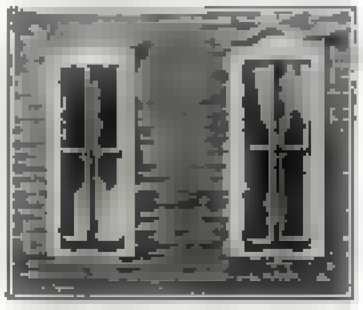
(Continued on page 139)

The Shipshape Home

(Continued from page 138)

Cheap Storm Windows

INSTEAD of going to the expense of buying new storm windows for my home, I made use of the old outside blinds, which had been discarded but were still in excellent condition. I sawed out the slats and inserted two panes of glass in each blind. The glass was held in place by means of thin strips of wood or glass beads, as they are called.—E. H. SCHLESSMAN.

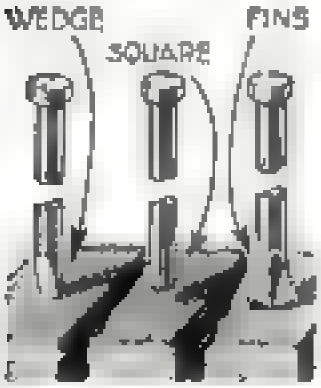


Neat storm sash made from old blinds

Hints on Nailing

NAILS are used so frequently in keeping a house shipshape that every amateur mechanic should know the various tricks that will enable him to drive a nail, even near the edge of thin boards, without splitting the wood

When working with brads or nails of relatively small size, file the point of the nail to a wedge shape, if a file is handy, and drive it with the chisel edge across the grain of the wood. If a file is not at hand, cut the point off entirely with pincers or pliers, or hold the nail against a piece of iron and hammer off the point Drive the nail with the blunt point. The advantage of these two methods is that the blunt nail will crush the wood instead of splitting it, as is the case with a nail having the ordinary point



Non-splitting points

Here is a little-known method for overcoming the splitting tendency with larger nails, that is, sixpenny, eightpenny, and up. If you will look at a common wire nail, you will see a series of corrugations on two sides under the head, and, on opposite sides at the point, a small fin or wing. These fins vary in size, but are present in some degree on all kinds of nails

The splitting of boards can be reduced or overcome without loss of much time by watching for nails with the larger fins and driving them with the fins across the grain.—A. J. H

Needle Points for Glazing

BEFORE puttying a new pane in a window, I fasten the glass in place with old phonograph needles. I find these are easier to drive than the regular V-shaped glazier's points. Phonograph needles are equally useful in holding picture-frame backs in place and for other purposes when very sharp steel points are needed in the home workshop.—DAN GERRITY.

How Much Do We Inherit?

(Continued from page 28)

for which environment alone is responsible. Tuberculosis, for example, biologists explain, is not inherited. A weakened constitution is, and the child of a tubercular parent is quite likely to be weak. Add to this the fact that the child arrives in a household where it is constantly exposed to tuberculosis germs, and one can understand why the child contracts the disease.

Possibilities of inheriting mental disorders often are real causes for concern. Insanity and feeble-mindedness are stalking family skeletons, eugenics shows, that never will disappear so long as a single afflicted member in the family, even though himself normal, has children. They both are dominant and cannot be bred out. The same is true of criminal ten[illegible].

AS FOR genius, one of the Chicago machines shows that the children of brilliant men rarely inherit their fathers' talents. If a brilliant father and a normal mother marry, the father's brilliance will not appear in his children, but may appear in his grandchildren. If, however, both the father and mother are unusual in the same lines, at least one-fourth of the children tend to be similarly [illegible].

We say that we all are born free and equal, but that is far from true, according to investigators of heredity. Brain capacity is inherited and it is impossible to educate a person beyond his limit.

Several eminent scientists have been experimenting in the last 10 years to learn whether the effects of mental training could be passed on. Doctor E. C. MacDowell at Cold Spring Harbor recently presented his conclusions after many years of work. He tested the ability of 200 rats to find their way to food in a maze. He found that no matter how carefully one generation was trained, there was no improvement in the offspring in knowing how to reach the food. His conclusions were strengthened by those of other experimenters at about the same time.

Were we to realize that we are built to patterns—half furnished by the mother and half by the father—that these patterns, when complete, are made of non-shrinkable, non-stretchable material—in other words, that we are and can be only what our chromosomes make us, science points out, we might realize the importance of fitting together the right sort of pattern pieces.

Plant and animal breeders are applying the mechanics of heredity daily, bringing forth wonderful rust-resisting wheats, delicious fruits, sheep with valuable coats, horses with great speed. Human beings carelessly mix good and bad traits in one grand jumble. Heredity machines such as those in Chicago will at least point out graphically to men what could happen if they cared to use foresight. For should men mate as race-horses are bred, eugenists urge, they might insure for the future a race of beings godlike in beauty, strength, and intelligence.

What a Junkman Learned

(Continued from page 29)

nated Frank, with an air of much practical wisdom, "is one of the big reasons why cars disappear off the roads. I have seen a seven-ton truck laboring under 20 tons of marble. I have seen passenger cars tested for 1000 pounds carrying 2000 pounds of human luggage and excess baggage. There's nothing that will make a car fit for the wrecker quicker than such abuse."

"But of course, there are lots of other cars that pass out of use as the result of pure mischance, or from inexperience in driving. I know of one man who took his family to the beach for a Sunday outing and parked his car headed toward a bulkhead along the shore. After a while he decided to change his parking place.

He had forgotten he had left the car in gear. He stepped on the starter, and the machine lunged forward. He got rattled. Instead of throwing out the clutch and jamming on the brake, he put his foot on the accelerator. The car plunged over the bulkhead and into six feet of water. Two of his family were drowned. The car went to the wrecker."

Frank the Auto Wrecker could tell you of many another such tragedy of the road—dramatic stories that are brought to him every day. His piles of automobile "bones" form a startling and often gruesome museum of the thoughtless and foolhardy things that drivers do with their cars.

Yet, though he profits from the mistakes and recklessness of others, he is by no means the cold-blooded ogre. He sympathizes with the costly griefs that motorists bring upon themselves. He is eager to pass on to them the practical wisdom he has gathered from "chopping up cars into hash."

"Tell them," he repeated, "that the most important thing of all is good oil."

Recent Publications

Practical Steam and Hot Water Heating and Ventilation, by Alfred G. King. Description of all materials and appliances used with modern heating and ventilation systems. Construction details, rules, and tables are included. Illustrated. Norman W. Henley Publishing Company.

Survival. Evidences of life after death as described by twelve eminent British scholars, including Sir Oliver Lodge and Sir Arthur Conan Doyle. G. P. Putnam's Sons.

Genetic Studies of Genius, by Lewis M. Terman. Results of tests given a thousand gifted children in California to determine their physical, mental, and personality traits. Stanford University Press.

The Einstein Theory, by Samuel H. Guggenheimer. A popular discussion of the Einstein theory, emphasizing its bearings and significance. The Macmillan Company

Education through Wood Working, a series of essays by teachers of woodworking, compiled by the American Woodworking Machinery Co., Rochester, N. Y.

Interaction between Vessels, by R. B Bodily, Commander, R. N. Van Nostrand Company.

Simple Inventions Most Profitable

(Continued from page 77)

official position in the company in payment for his patent. But my usual method, after I have secured a patent and devised marketing plans, is to start manufacturing the invention myself. Then, after I have proved that a demand for it exists, I have little trouble selling the patent at a good figure to some manufacturer in a kindred line, or to some one who wants to get into the manufacturing business. Once you have proved that people will buy a patented article it is easy to sell the invention profitably."

THIS man invariably has invented things that many people need—among others, a flat collar button that relieves the pressure on the back of a man's neck, and an alarm bell that, attached to the drip-pan of a refrigerator, indicates when the waste water in the pan is about to overflow.

In no field of human activity have the possibilities of profitable invention been exhausted. Every great basic invention is followed by hundreds of profitable lesser inventions.

One of the early motor fortunes was made by a man who invented an automobile horn. When the automobile was new, the warning devices then in use were lulling to the ear. The inventor decided that something startling was needed, and he devised a horn with a "hoot" that convinced the most absent-minded pedestrian that it was time to move.

In this case the demand was not waiting, and an extensive advertising campaign was necessary to convince the motoring public of the merits of the new horn. But in the end the inventor won out, and made a large fortune.

While Henry Ford and a host of other automobile inventors have been making their millions in motors, people have continued to walk on sole leather. They have been doing that for several centuries, and footgear seemed to offer a barren field for inventive genius—until the inventor of the rubber heel appeared. Now 90 per cent of American men and 20 per cent of American women wear them.

Elias Howe's idea of putting the hole in a sewing-needle near its point instead of in its head made him a profit of more than a million dollars, and by making possible the sewing-machine, laid the foundations for several big fortunes beside his own. The four-motion feed invented by Allen B. Wilson made him a rich man. Singer, who had to borrow $40 to pay for making a model of his machine, lived to receive an income of $3,000,000 in a single year. James C. H. Gibbs also made a fortune.

BUT to get back to simpler inventions. We have become so accustomed to finding a rubber eraser attached to our lead-pencils that we have forgotten that until 1858 pencils did not have this convenience. Hyman L. Lipman was the inventor who hit upon this trouble-saving device, and he profited to the extent of several hundred thousand dollars.

For a long, long time people have been buying and selling various liquids in bottles, and for as long a time they have been looking for a stopper that was secure, convenient, and inexpensive. The first improvement over the old-fashioned cork was a rubber stopper tightened by an outside wire attachment that acted as a lever. Its inventor made $15,000,000. Then came a Baltimore inventor with a metal bottle cap that was cheap and secure. He also made a fortune. There is probably another fortune waiting for the man who patents a cap as inexpensive and as secure as the one now used, but that can be taken off without the aid of a bottle-opener.

THE use of cans as containers of food led to the inventions of various types of can-openers. In spite of these aids, opening cans remains one of the annoyances of modern life. Perhaps it will be abolished by the recently invented can that has a seam just below the top that, when struck, opens the can. A big Chicago packer thought so well of this invention that he gave a first order for 10,000,000 of the cans. Manufacturers of shoe polishes are said to be willing to pay well for a polish tin that is airtight, easy to open, and inexpensive to manufacture.

A few years ago an inventor decided that amateur photographers would find it a convenience to be able to note on their films the date on which each picture was taken and other memoranda. He invented the autographic film and made $300,000. A rug-display rack brought its inventor $30,000. A glass lemon-squeezer made $50,000 for the man who patented it. The inventor of the grooved umbrella rib made almost a million dollars. A tire chain to keep automobiles from skidding on slippery roads was worth as much to its inventor.

Shipping tags used to have a troublesome habit of tearing loose from their twine or wire fastenings. An inventor devised a tag with the eyelet reinforced by a stiff paper ring. Simple—but it made a fortune for him, and around that invention a great business has been built.

The habit of keeping both eyes wide open for possible improvements in articles already in use is a valuable asset for the would-be inventor. A good many million paper bags have been used by clerks, but they left it to a shop girl to invent the satchel-bottom paper bag. She sold the patent for $24,000. That was only a thousand dollars less than King George V of England got for the patent for a movable fireplace for workmen's dwellings.

THE successful inventor must be able to form an accurate estimate of how great a demand there will be for his invention. Some years ago a young man devised an ingenious method of automatically counting the number of words written on a typewriter. A typewriter manufacturer offered him $10,000 for the patent. The inventor laughed scornfully. He did not stop to think that it is easy to

(Continued on page 141)

Profit in Simple Inventions

(Continued from page 141)

estimate, accurately enough for most purposes, the number of words on a typewritten page. He didn't make a cent out of his very clever invention.

Motion pictures have opened another rich field for invention. Sixty-eight per cent of the American public goes to the movies, and 150,000 films are made each year. Any device, simple or complicated, that will make motion pictures better will find a ready sale and should bring its inventor large returns.

Radio, likewise, still is in its scientific and industrial infancy, and offers unbounded opportunities to the ingenious and wide-awake inventor.

AMERICANS spend a million dollars a week for sporting goods, and a large proportion of these dollars is paid for golf supplies. The man who patented the golf tee already described is not the only one who has realized the possibilities of invention in the game that holds the interest of so many of our citizens. A single number of *The Official Gazette*, issued weekly by the Patent Office, contains notices of the granting of patents for a golf club with a pivotally mounted head that is adjustable to the stance of the user, for a golf-bag latch, for a golf club built like a split-bamboo fishing-rod, and for two patent golf tees.

This *Official Gazette* of the Patent Office is the current history of American invention. Glance through its pages and you will get a picture of the wide sweep of inventive genius. In one week patents were issued for an ore-smelting furnace, a fireproof legging, a garbage receptacle, a station indicator for radio receiving sets, a can-opener, a rudder retainer for airplanes, a paint-bucket stand, an airship with a buoyant keel by means of which the ship may rest on the water, a fishhook holder, a belt-lacing needle, an articulated link for the cartridge belts of machine-guns, an asphalt shingle, an automatic telephone system, a fountain safety razor, a tractor mower, a window lock, a valve for milk-pasteurizing tanks, a baseball, a log-loading machine, a die for forging clawhammers, a card game, a nail-puller, several can-openers, a compressed-air motor for pumps, and a shoe insole.

THESE are just a few of the 875 patents issued in a single week. They range all the way from complicated inventions that have taken years of study to perfect, to simple little devices that sometimes are the result of a swift thought and a few hours of experimenting. Some of these patents may win fortunes for their owners, others will not be worth the trouble of getting them.

Every 13 minutes an invention is made that is patented. Yet there are not enough inventions. Every day the modern world develops new needs. It is the inventor who must fill these needs. If, before devoting too much time to his invention, he will make sure that it does fill a real need, he will find a market waiting for it, and a fortune waiting for its inventor.

Money Making Opportunities for "Popular Science" Readers

Readers of POPULAR SCIENCE MONTHLY will find scores of opportunities in this section (pages 144 to 174) for making more money.

Every reader of POPULAR SCIENCE MONTHLY *is invited to enter this contest—*

$100 in CASH PRIZES

For the best letter of 100 words or less answering the question—

"What advertisement in the 'Money-Making Opportunities' Section interests you most—and why?"

we will pay on December 10th, the following cash prizes:

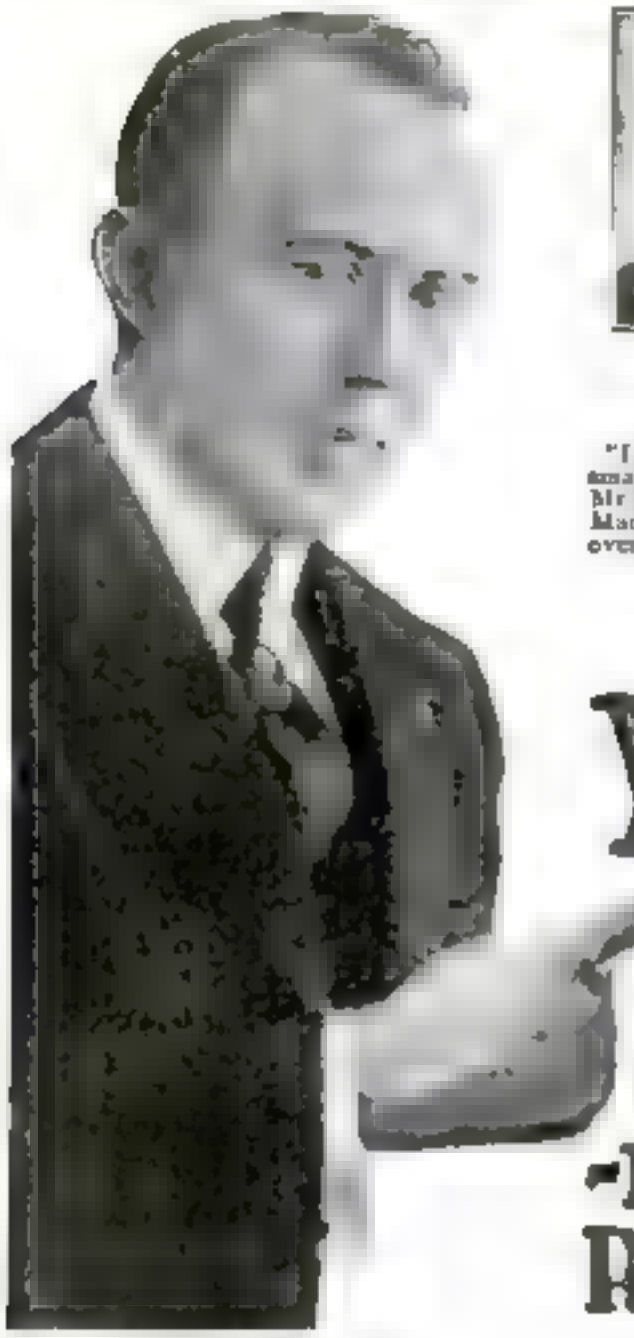
FIRST PRIZE	$50.00
SECOND PRIZE	25.00
THIRD PRIZE	10.00
FIFTEEN PRIZES OF $1.00 EACH	15.00

First read every advertisement in the Money-Making Opportunities Section on pages 144 to 174. Pick out the one that interests you most and then write a letter—not exceeding 100 words—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on November 1st. The prize winners and their letters will be published in the January issue of POPULAR SCIENCE MONTHLY.

Address your letter to

Contest Editor
MONEY-MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York



J. E. GREENSLADE

JACK WARD
Chicago

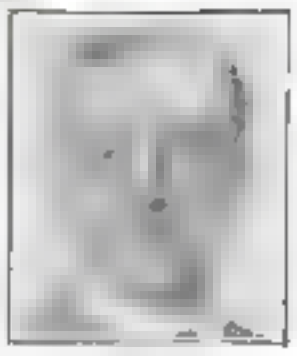
"I didn't want to work for small pay. Frankly, I scoffed Mr. Greenslade was right. Made $13,500 last year over $1,000 every month."

WARREN HARTLE
Chicago

After 10 years in the Railway mail service I decided to make a change. Earned more than $1,000 the first 30 days."

F. WYNN
Portland

Last week my earnings amounted to $546.37 this week will go over $400.00. Thanks to the N. S. T. A."



CHARLES V CHAMPION
Illinois

"I'm now President and my earnings for 1925 will easily exceed the five figure mark. Thanks to your training."

You're Fooling Yourself

-if You Think These Big Pay Records Are Due to LUCK!

But don't take my word for it! When I tell you that you can quickly increase your earning power; I'll PROVE IT! FREE! I'll show you hundreds of men like yourself who have done it. And I'll show you how you can do it, too

I'LL come directly to the point. First you'll say, "I could never do it. These men were lucky." But remember the men whose pictures are shown above are only four out of thousands and if you think it's luck that has suddenly raised thousands of men into the big pay class *you're fooling yourself.*

Easy to Increase Pay

But let's get down to your own case. You want more money. You want the good things in life a comfortable home of your own where you can entertain a snappy car, membership in a good club, good clothes, advantages for your loved ones, travel and a place of importance in your community. All this can be yours. And I'll prove it to you, FREE.

First of all get this one thing right: such achievement is not luck—it's KNOWING HOW! And KNOWING HOW in a field in which your opportunities and rewards are ten times greater than in other work. In short, I'll prove that I can make you a Master Salesman—and you know the incomes good salesmen make.

Every one of the four men shown above was sure that he could never SELL! They thought Salesmen were 'born' and not "made!" When I said, 'Enter the Selling Field where chances in your favor are ten to one," they said it couldn't be done. But I proved to them that this Association could take any man—regardless of his station in life, regardless of his present job, or lack of selling experience—and in a short time make a MASTER SALESMAN of him—make him capable of earning anywhere from $5,000 to $10,000 a year. And that's what I'm willing to prove to you, FREE.

Simple as A B C

You may think my promise remarkable. Yet there is nothing remarkable about it. Salesmanship is governed by rules and laws. There are certain ways of saying and doing things, certain ways of approaching a prospect to get his undivided attention, certain ways to overcome objections, batter down prejudices and outwit competition.

Just as you learned the alphabet, so you can learn salesmanship. And through the NATIONAL DEMONSTRATION METHOD—an exclusive feature of the N. S. T. A. System of Salesmanship Training—you gain the equivalent of actual experience while studying.

Years of Selling Experience in a Few Weeks

The N. S. T. A. System of Salesmanship Training and Employment Service will enable you to quickly step into the ranks of successful salesmen—will give you a big advantage over those who lack this training. It will enable you to jump from small pay to a real man's income.

Remarkable Book, "Modern Salesmanship" Sent FREE

With my compliments I want to send you a most remarkable book, "Modern Salesmanship."

It will show you how you can easily become a master salesman—a big money-maker—how the N. S. T. A. System of Salesmanship Training will give you years of selling experience in a few weeks; how our FREE Employment Service will help select and secure a good selling position when you are qualified and ready. And it will give you success stories of former routine workers who are now earning amazing salaries as salesmen. Mail the coupon today. In every man's life there is one big moment when he makes the decision that rolls him of success—or leads him on to fortune. This may be your turning point. You may be face to face with *your BIG* opportunity. Send the attached coupon at once and you will have made the first stride toward success.

NATIONAL SALESMEN'S TRAINING ASSOCIATION
Dept. S-15 N. S. T. A. Building, CHICAGO, ILL.

National Salesmen's Training Association,
Dept. S-15, N. S. T. A. Building,
Chicago, Ill.

Send me free your book, "Modern Salesmanship" and Proof that I can become a MASTER SALESMAN.

NAME .....

ADDRESS .....

CITY..... STATE .....

AGE..... OCCUPATION.....

When Your New Set Arrives

(Continued from page 62)

sulating material is, of course, such stuff as hard rubber, glass, porcelain, or any of the other compounds specially recommended as insulators.

After the antenna is connected with the receiver, the next job is to install the ground connection. The latest rules of the fire underwriters allow the use of bare copper wire not smaller than No. 14 gage, and since the ground wire need not be insulated, you can run it along a corner of the floor where it will not be noticed. One end of the ground wire connects with the ground binding post on the receiver and the other end with a ground clamp fastened around the nearest cold-water pipe.

If you use storage batteries, be sure to place a rubber mat or glass tray under them. It is not necessary to keep the wires from the batteries to the radio set separated from each other, provided, of course, that they are insulated wires, but if you bunch them together, be sure that you do not make a mistake and connect the wires from the B batteries in place of the A battery.

What Is Your Problem?

Answer these questions before you install your radio receiver:

1. Where is the best place for the antenna?
2. In what room shall I put the radio receiver?
3. How can I hide the batteries?
4. Where will the loudspeaker sound best?
5. Will special lighting be necessary?

If any of these problems are bothering you, POPULAR SCIENCE MONTHLY stands ready to help you with advice or information. Be sure to write us full details.

IT IS always well, in any case, to connect each wire with receiver first, and then run it to the proper terminal of the battery rather than the other way around, because in the latter case, the loose end of the wire that already is connected with a terminal of the battery may move around and accidentally short circuit against some other wire or binding post.

Although the length of the wire between the radio receiver and the loudspeaker is not important, you probably will find that the loudspeaker sounds best from some one particular position in the room. It is well, therefore, to experiment a bit after you have the whole outfit working properly. Usually you will find that the best position is near one corner of the room where the joining walls act to reflect the sound and help to reinforce, through resonance, the deeper tones.

WHAT is considered a record for amateur radio transmission was made recently by Gerald Marcuse, a London amateur expert, who spoke several mornings direct to the wireless operator aboard a warship stationed at New Zealand—12,000 miles.

Get a Job Like These

$20 a Day for Schreck

[illegible] ... I used to make $5 a day.

A. Schreck, Phoenix, Arizona.

Makes $700 in 24 Days in Radio

"Thanks to your interesting Course [illegible] ... your training has done for me."

[illegible] C. McNabb, [illegible], Atlanta, Ga.

PLANT ENGINEER—Pay Raised 150

"I was a dumbbell in electricity until I got in contact with you Mr. Cooke, but now I have charge of a big plant including [illegible] motors and [illegible] electric [illegible] etc. My salary has gone up more than 150%."

George Illingworth, [illegible]

$70 to $80 a Week for Jacquot

"Now I am [illegible] in Auto [illegible] ..."

Emil Jacquot [illegible], Colorado.

$1000 a Month for Jirinec

"You will be glad to know that my business is now [illegible] ... thank for what I've done."

John Jirinec, [illegible] Fourth Ave., Astoria, N. Y.

Learn to Earn $3,500 to $10,000 a Year

ELECTRICITY ~The Big-Pay Field~ NEEDS YOU NOW

I Will Train You at Home—Spare time Only Needed

Don't you keep on working for only $25 or $35 a week. Get into Electricity. Thousands of Cooke Trained Men who knew nothing about it a short time ago are now earning $70 to $200 a week as Electrical Experts—and they don't work half as hard as you do. Why stick to your small pay job? Why stick to a line of work that offers no chance—no promotion—no big pay? Get into the world's greatest business. Electricity needs you. I'll show you how to do it. Get ready for a big pay job now.

Electrical Experts Are In Big Demand

Even ordinary electricians—"the screw driver" kind—are making big money, but trained men—Electrical Experts who get the top salaries—are needed more now than ever before. Thousands of Cooke Trained Men easily earn $3500 to $10,000 a year. That's the kind of job you want—where you can plan, and boss and supervise the work of others or go in business for yourself. Get started towards one of these big-pay jobs now. Learn to earn $70 to $200 a week—you can do it with Cooke Training—recommended by more than ten thousand successful graduates. Just mail the coupon below.

Employment Service and Help—No Extra Charge

I will train you for a big pay job and help you get it without extra charge. Hundreds of Employers look to me for the electrical men they hire. Last year I placed over one thousand men at big raises in pay. Hundreds of others were promoted by their employers through the help of my Vocational Service and other hundreds went into business for themselves with the help of my special Business Training. Mail Coupon for big free book which explains this service and fourteen other features, many of which can't be had anywhere else.

Age or Lack of Experience Bars No One

You don't need experience. You don't have to be a College man. You don't have to be even a high school graduate. As Chief Engineer of this big two million dollar institution which does a general Consulting Engineering Business besides operating one of the world's greatest Training Schools, I know just what training you need to make a big success in electricity. Let me give you that training with my simplified complete home course—the world famous "Cooke Training"—built on my own 20 years of engineering experience with the help of nearly 50 other engineers. Learn to earn $70 to $200 a week—Only spare time needed.

My Training Pays For Itself

You can start earning extra money a few weeks after you start my training. I give you special instruction for doing simple electrical jobs in your spare time—show you how to get these jobs and tell you what to charge. Many of my students make as high as $25 a week extra this way while studying. My course more than pays its own way.

Your Satisfaction Guaranteed

I am so sure I can make you a big success in Electricity, just like I have done for the men whose pictures you see here and thousands of others who now boost my training that I will guarantee your satisfaction with a signed, money-back guarantee bond. If my training doesn't satisfy you after you have finished, you get back every penny you pay me. A two million dollar institution stands back of this guarantee.

Get Started Now—Mail Coupon

Get my big free book—"The Vital Facts about Electricity." Read about the success of hundreds of other men who recommend this training and whose names and addresses are being given in my book. Get the real dope about your opportunities in Electricity. See how easy it is to get started on the road to jobs that pay $70 to $200 a week.

Don't deny yourself this chance to make big money. Get the facts—Mail Coupon at once for facts and my guarantee.

L. L. COOKE, Chief Engineer,
Chicago Engineering Works, Inc.
Dept. 38, 2150 Lawrence Ave.,
CHICAGO, ILLINOIS

5 Wonderful Working Outfits Free to Students

1. **LABORATORY AND EXPERIMENTAL OUTFIT.** Complete material for interesting experiments.
2. **BELL AND ALARM OUTFIT.** Electrical apparatus, material and tools—a complete installation kit.
3. **ELECTRIC LIGHTING OUTFIT.** Wire, fuse box, lights, etc. Everything needed to make up all complicated electric lighting circuits.
4. **ELECTRIC POWER OUTFIT.** The Famous "Cooke" Motor and other apparatus. Not a toy—but a real, honest-to-goodness workable machine.
5. **TRANSFORMER OUTFIT.** Complete parts for building and winding this widely used equipment.

Get this Big Book Now!

L. L. COOKE, Dept. 38, 2150 Lawrence Ave., Chicago — The Man Who Makes "Big Pay" Men

Send me at once without obligation your big illustrated book and complete details of your Home Study Course in Electricity, including your outfit and employment service offers.

Name..

Address..

Occupation..

A Simple Crystal Set

(Continued from page 59)

of condenser *C* alters the electrical capacity of the condenser and when the signal becomes loud, it is because the capacity of the condenser has been so adjusted that the combination of coil *B* and condenser *C* has been tuned so that the current flowing back and forth can keep time with the changes in the current in coil *A*.

Naturally you cannot hear vibrations in the air that are changing as rapidly as 1,500,000 times a second. In fact, the highest note the human ear can hear has about 30,000 vibrations a second.

The voice or music going into the microphone at the broadcasting station has the effect of chopping the radio wave into sections and the sections are in time with the music. This is where the crystal detector comes in. Its function is to block off half of each radio wave so that the whole group of rapidly changing waves that form one vibration of the music will act together to pull the diaphragm of the head phone in one direction. Then the next group of radio waves comes along and gives it another pull, so that it moves back and forth in time with the music and you can hear it.

The reason that a crystal radio receiver will bring in music only from short distances is because the sound in the head phones when you use a crystal set actually is produced by the energy of the radio waves themselves. In a vacuum-tube receiver, on the other hand, the radio waves simply are used as triggers to release relatively far more powerful bursts of energy from your batteries. And this explains why reception with a crystal receiver is so true to life. There is no chance for distortion to creep in, due to faulty vacuum tubes or batteries.

What Our Readers Say

Downright Enjoyment

I believe that for downright enjoyment to a man of mechanical inclination there is no better magazine published. Certainly I enjoy nothing more than keeping abreast the world of science and invention, made possible by POPULAR SCIENCE MONTHLY.—A. K. M., Bowden, Alta., Can.

From a Home Worker

I have made a good many things that I have learned how to build from POPULAR SCIENCE MONTHLY. I have made footstools with springs, hatracks, kitchen tables, workshop bench, writing-desk, chest, tool cabinet, trellises for the house, just in my spare time, and I am very interested in your magazine.—J. J. B., Binghamton, N. Y.

Mines of Information

I always have taken the greatest interest in the Home Workshop and Shipshape Home sections and for a long time have been cutting out the "tidbits" of special interest and putting them in scrap albums. Consequently my albums are regular mines of information, and the envy of my mechanically minded friends. —E. B. R., Regina, Sask., Can.

Here Are Correct Answers to Questions on Page 39

1. This is a case of the work of the yeast plant. Fermentation means merely that yeast is growing in the cider. The yeast produces alcohol and carbon-dioxide gas just as it does in bread and that is where the bubbles of gas in the cider come from.

2. Probably the dog, though it is possible that in some parts of the earth the sheep or the pig may have been partially domesticated before the dog was, or at about the same time.

3. They indicate the frequency of a wave. One "cycle" means one complete wave. A "kilocycle" is 1000 cycles or waves.

4. There is no evidence that they are changing at all. Some prehistoric men were short and some were tall, just as men are today.

5. No. There is no recorded case of any one having been hit. Most of the falling stars are so small that they do not reach the earth's surface at all, but burn up by friction in the upper part of the air, making the streaks of light that we call "shooting" stars.

6. Yes, put it in a vacuum. The temperature at which water boils depends on the air pressure—the less the pressure, the lower the temperature necessary for boiling. Water placed in an ordinary vacuum will boil at about 50 degrees Fahrenheit

7. This is another instance of blood leaking out of the blood vessels. The flesh around the eye is rather loose and spongy. When blood gets out into this tissue, it spreads around for quite a distance and makes the whole neighborhood of the eye look blue or black.

8. They do not differ at all in chemical composition. Both are composed of oxide of aluminum. In both cases the red color is due to a little impurity. In the artificial stones this is added on purpose

9. In the center of the whirl of the storm, the black funnel that corresponds to the waterspout at sea, the centrifugal force of the air, makes a partial vacuum. If this vacuum passes over a house the air inside the house does not have time to escape through the windows and doors, so it blows up the house.

10. Yes. Some low forms of animals become females when fed on plenty of food or on certain kinds of food. When fed on other kinds of food or given too little of it, the same animals become males.

11. Yes. The action of our nerves is believed to be electrical. Other electrical changes are taking place all the time in our bodies. All these are very small in amount. We cannot produce at any one time enough electricity to cause a shock or to be perceptible at all, but delicate scientific instruments can detect our bodily electricity easily.

12. It has, by far, the best blood supply of any organ in the body. The gray matter that we think with is especially rich in blood vessels and the continual stream of fresh, rich blood around the masses of nerve cells in it brings to the cells the food they need

Unmasking Spirit Fakers

(Continued from page 14)

Thus, I have heard an alleged spirit of George Washington speaking with an unmistakable cockney accent. I have heard the "spirit of Shakespeare" make grammatical errors and use modern slang. It was something of that sort that caused me first to doubt the good faith of the average medium. When I was about 16, I attended a series of séances given by a medium—a tailor—at Beloit, Wis. At the time I was a confirmed believer in spiritualism. This medium had impressed me greatly by the fact that he habitually put his sitters in touch with the spirits of great men—George Washington, Abraham Lincoln, Napoleon, Columbus—his séances were a constant panorama of history.

ON THE night that the "spirit of Lincoln" began to address us, my interest mounted high, for Lincoln was my hero of heroes. I had read and studied every Lincoln book that was available at the time. I knew every published detail of the Great Emancipator's life. And I was vaguely conscious that night of something about the utterances of the "spirit" that did not ring quite true. So at last, I asked

"Mr. Lincoln, what was the first thing you did after your mother was buried?"

"I felt very bad," replied the "spirit" gr[illegible] I went to my room, and I wouldn't speak to any one for days."

Now, that reply probably would have been correct in a majority of cases, but it was not correct with regard to Lincoln. For Lincoln's first act when his father had buried his dead mother was to rush off to engage a clergyman to read a burial service over her grave—an act of respect which his father had neglected! And this was certainly not an incident which Lincoln was likely to forget—in the spirit world or elsewhere.

Although this happening did not shake entirely my faith in spiritualism, thereafter I watched closely the methods by which the tailor-medium accomplished his effects. One thing I noticed was that no matter how many "spirits" talked at his séances, only three voices would be heard, and these same three voices were heard at all séances, no matter what "spirits" appeared. When I inquired from the medium the reason for this, he looked at me intently for a moment, then laughed in an embarrassed way and said

"Well, you've caught me; but you've got to admit that I do more good than harm by consoling sorrowing people who long for a message from their loved ones!"

CAUGHT him! I had no intention of catching him! On the contrary, it came as a painful shock to me that one whom I had trusted and believed in completely should so readily confess himself a fraud. When I had asked him about the voices and an odd buzzing noise I frequently had heard in the trumpets which he used, I had been innocently seeking information about what I regarded as my religion. However, I was quick-witted enough to take advantage of his unexpected revela-

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Unmasking Spirit Fakers

(Continued from page 152)

tion. I permitted him to infer that I had been on to him all along.

"But, surely," I asked, "all mediums are not like you? There must be some genuine ones?"

"None that I know of," he said with a grin. "They're tricksters—every one of them!"

And it is with sincere regret that I must report that my 25 years of investigation of mediums in all parts of the world have given me no reason to doubt the statement the tailor-medium made to me then.

For years I have offered—with never a successful challenge—as much as $10,000 to any medium who can produce under conditions laid down by me any physical manifestation of his boasted psychic powers that I cannot duplicate by the methods I use as a professional magician. I make this offer again in the columns of POPULAR SCIENCE MONTHLY

FOR years I have been duplicating the most mystifying feats of the mediums from the stage—and then explaining to the puzzled audiences exactly how the tricks are accomplished. My success in this work has caused believers in spiritualism to declare that I am a psychic—a medium—without realizing it myself. Such a statement is of course absurd. Every feat that I ever have performed on the stage or off has been accomplished by purely natural means that are explainable by the laws of science and that would be understandable to any one to whom I chose to divulge my secrets.

Once when a spiritualist was endeavoring to convince me that "spirits" aided me in performing the "escapes" that are part of my theatrical routine, I said to him:

"My friend, for many years I have been forced to sleep with a pillow under my back. That's because a gang of longshoremen crushed one of my kidneys with a chain while tying me up on a stage at Buffalo, N. Y. Why weren't the spirits on hand to help me then?"

He couldn't answer the question, of course, but I am quite sure if he is still living, he is still a spiritualist, for I have found that the objections one offers to even the most unfounded beliefs of spiritualists usually have scant effect. Spiritualists *will* believe—those of them, that is, who are not frauds, for I have encountered only two kinds of spiritualists—tricksters and the deluded persons upon whom they prey.

AND the latter are not to be shaken even by *proofs* that the "psychic manifestations" of mediums are accomplished by trickery. Mediums that I have caught red-handed—or black-handed, as the Cleveland medium I told of above—invariably have found stalwart defenders among those whom they have been fooling. After I had exposed a trumpet medium in New York City a few weeks ago, one of the medium's dupes attempted to attack me physically and only desisted on learning that police were in the room.

The spiritualist believers have a stock

(Continued on page 154)

Unmasking Spirit Fakers

(Continued from page 153)

excuse for a medium who is detected in trickery.

"Well, yes," they admit, "you caught him that time—but that was because he had suddenly lost his power. It's only in such cases that he's forced to resort to trickery."

For 35 years I have been encountering that kind of logic. It has been a severe test of my patience.

Even so noted a man as Sir Arthur Conan Doyle, author and scientist of world-wide reputation, creator of *Sherlock Holmes*, probably the most coldly, rigidly logical character in English fiction, many times has used much the same sort of specious reasoning when I have challenged the basis for his faith in spiritualism.

He is one who firmly insists that my stage tricks are performed with the aid of spirits; that I am a psychic. Once he went so far as to ask if I was "the last word in religion and science in America."

"WELL, Sir Arthur," I replied, "not exactly that. But, if you were to build a packing-case large enough to contain me and all the American spiritualists and the scientists that uphold them, weight it with pig iron, tie us up in it and throw it into the sea, I'd be the only one that would come up. But it would be trickery that would release me," I added.

Frequently you will hear some one speak of a medium about like this:

"He must be genuine. Why, the spirits that talked in his place told me things that nobody but myself knew."

Bunk!

Early last summer Police Commissioner Enright, of New York, asked me to lecture at the New York Police Academy, to explain to the members of the police force just how to go about detecting fraudulent mediums. The best and most direct way that occurred to me of doing this was by staging a séance, performing myself the tricks that the mediums use.

AFTER a little hocus-pocus to add solemnity to the occasion—my séance, by the way, was performed in broad daylight—the "spirit" with which I alleged I had established communication asked:

"Is Lieutenant Smith of the Eighteenth Precinct here?"

Much mystified, the lieutenant acknowledged his presence.

"I," said the "spirit," talking through me, of course, "am the spirit of John Brown, whom you saved from drowning at the foot of East Ninety-First Street in 1920. I want to thank you for that and to congratulate you on your promotion. There'll be another promotion coming to you soon. Tell your boy Joe not to worry about his examinations; he's going to pass. And tell your wife not to worry about the baby. The little girl will get through the hot weather all right."

Lieutenant Smith had never spoken to me in his life, nor I to him, so naturally he was thunderstruck when the "spirit" singled him out from the big crowd of policemen present to tell him all this.

(Continued on page 155)

Unmasking Spirit Fakers

(Continued from page 114)

No doubt you, too, would be similarly astounded were I—or a medium—to tell you something similar under similar conditions. And yet there is nothing astounding about it. I was able to call that lieutenant by name because I had learned his name from one of his brother officers. I was able to tell him about the rescue because the same officer had told me about it.

MY INFORMANT also told me that Lieutenant Smith had been promoted recently, that he was married, and that he had a boy of 12 and an infant daughter. Inasmuch as the schools were scheduled to close for the summer in a couple of weeks, it was easy for me to guess that Joe was worried about passing his examinations. And since summer was coming on, I was quite safe in assuming that Mrs. Smith, like every other mother I've ever met, would be concerned about how her baby was going to stand the hot weather.

Simple, isn't it? Yet how mystifying when you're not in on the secret!

A favorite dodge of the mediums, that one! Almost invariably they work it on newcomers to their seances. Sometimes the surprising personal details related by the 'spirit' are supplied by the spiritualist friend who has introduced the visitor, for spiritualists like to make converts, and if they can do so by helping the medium in his trickery, they'll do it.

GIVE a clever medium a man's name, address, and occupation information that readily can be obtained from the city directory—and with the aid of a few leading questions and a little deduction, the medium can convince that man that he knows the innermost secrets of his soul.

I do this sort of thing from the stage regularly as part of my work of exposing the tricks of fraudulent mediums. One of my most useful pieces of equipment in this connection is a library of city directories of the leading cities of the United States. With their aid I am able to tell persons in the audience most astounding things.

Thus, while playing in New York recently, my assistant, whom I had stationed in the lobby for the purpose, related to me a brief exchange of conversation between two men, overheard while they were passing through the lobby of the theater.

"Well, Mr. Blank," one said to the other, "how are things out in St. Louis?"

"Pretty good," replied the other; "we've sold a lot of cars this year."

With this much to guide me, it required only a moment to ascertain from the St. Louis city directory the full name and address of a Mr. Blank—the name I use is fictitious—who was in the automobile business in that city. Later from the stage I called Mr Blank by name, told him his business, made the obvious guess that it was business that had called him to New York, gave him the assurance of the "spirits" that his business trip would be successful, and otherwise astonished

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Unmasking Spirit Fakers

(Continued from page 155)

him and the audience by my supposedly spirit-given knowledge of his personal affairs.

AT ANOTHER performance in the same theater I absolutely flabbergasted a man in the audience by calling him by name, and informing him that he had come to the theater to escape from a quarrel he was having with his wife.

I knew this because I myself had observed the couple quarreling on the sidewalk before the performance began, had heard the wife call the man by name, and had seen him rush into the theater and buy a ticket.

On account of the prominence of the persons named, a demonstration of this sort of mediumistic trickery which I gave in a Boston theater not long ago caused quite a stir.

"Is John Lewis Bates in the audience?" I asked from the stage, naming a former governor of Massachusetts.

Governor Bates acknowledged his [redacted]

"The spirit of the late Governor Curtis Guild is here," I announced. "Probably you don't believe this, but I'd like to convince you. The spirit wants to know why you cut off the side whiskers that you used to wear. You used to wear side whiskers, didn't you?"

"Many years ago," replied the ex-governor.

"THE spirit also wished to know if you recall having dined with him at the Algonquin Club in Boston when he was governor about 20 years ago."

"I recall it very well," was the response.

"He wants to know if you recall the subject discussed. It was Jesse Pomeroy, wasn't it?" I asked.

"Yes," replied Mr. Bates, thoroughly astonished, while the audience gasped in amazement. "But how did you know?"

The explanation is almost unbelievably simple. I knew, of course, that former Governor Bates was in the audience. I also knew that he had formerly worn side whiskers, for I had seen him wearing them on another visit to Boston about 25 years ago. Also, former Governor Curtis Guild, journalist and soldier, was my personal friend. I had been his guest at the Algonquin Club in Boston. He had told me that it had been a customary procedure to present a petition for the pardon of Jesse Pomeroy, the famous boy murderer, to each successive governor of the state. Knowing all this, it was easy for me to piece together the tale I unfolded to him from the stage that night. A few facts, and a little artful guessing—that is all the material a clever medium requires to mystify the average person.

NEXT month Houdini will tell other dramatic stories of his adventures with spiritualistic fakers, revealing secrets of their tricks and explaining the ingenious and often startling ways in which he has exposed them. You won't want to miss the second installment of Houdini's own story in the December issue.

There's Magic in Numbers

(Continued from page 30)

numbers and compare the result with the answer on the folded slip. They will be identical.

The secret of this stunt lies in the third and fifth numbers. When you set these down, you see to it that each digit when added to the corresponding figure above set down by the subject, totals 9. This is how it works:

Subject's figures		16,942
Subject's	"	26,453
Your	"	73,546
Subject's	"	39,201
Your	"	60,798
	Total	216,940

ALL you have to do to get the total is to add a 2 at the left of the original figure and subtract a 2 from the right. Thus you can tell quickly at the start what the total will be.

What you really have done is to add a pair of 99,999's to the original number. This is 2 less than 200,000. By adding a 2 at the left and taking away a 2 from the right, you actually have added the 200,000 minus 2

To make this trick very mystifying, use a confederate who pretends to be ignorant of how it is done. Let him put down the third and fifth numbers, then you yourself, apparently, have had nothing to do with the figures, and how you got the answer by seeing only the first number will be astounding to your audience.

A similar trick is one in which you always get the same total. Ask the victim to write down a number of three figures in which the last figure is 2 less than the first one. Say he chooses 836. Tell him then to write the figures backward and subtract them from the original, reverse these and add. Thus—

Number in mind	836
Reverse and subtract	638
Result	198
Reverse and add	891
Total	1089

The answer always will be 1089, no matter what numbers are used. But this trick, to be really effective, requires a bit of staging. When your victim has finished his calculations, ask him to let you know what the third digit of his answer is. You then pretend to ponder deeply before announcing the answer

ANOTHER interesting pastime with figures is to be found in numerology, which purports to be a science that determines the influence on your life of numbers corresponding with the letters of your name. Every letter of the alphabet is supposed to have a corresponding number, and each number is supposed to have a specific meaning. The letters of your name, reduced to their corresponding numbers and added, are supposed to give you the key to your character and your possibilities for fortune.

Obviously scientists agree that there is no science whatever in numerology, yet it offers an interesting fortune-telling game.

To analyse your name, first reduce the letters in the name to numbers by the

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There's Magic in Numbers

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following table, reading it downward

1	2	3	4	5	6	7	8	9
A	B	C	D	E	F	G	H	I
J	K	L	M	N	O	P	Q	R
S	T	U	V	W	X	Y	Z	

Now add the numbers of all the vowels in your name. The total is supposed to tell you what your inner characteristics are. Next add the numbers of all the consonants. The resulting number is supposed to indicate what outer influences for success or failure are attracted to you. The sum of vowels and consonants together is supposed to give you the full meaning of your life. Since there are only single numbers in the table of meanings given below, you must reduce any double numbers in your totals to a single figure. Thus if your total happens to be 46, add the 4 and the 6, making 10. Then add again, 1 plus 0 equals 1. The total to be interpreted then is 1.

The numbers and their meanings are as follows:

1. Courage, independence; the pioneer.
2. Tact, kindness, and conventionality; domesticity
3. A combination of 1 and 2—a many sided nature.
4. The symbol of failure, money troubles, and tragedy.
5. The rolling stone, restlessness, short-lived enthusiasm, inability to "stick."
6. Most stalwart of all numbers; honesty; the good citizen.
7. Symbol of loneliness and misunderstanding; beauty of spirit, gentleness, and poetry
8. Material success, wealth and power.
9. Success in the arts; talent, imagination.

FOR example, suppose your name is "John Roberts." You would figure it out like this

		Total 17
Vowels	6 6 5	(equals 8)
	JOHN ROBERTS	
Consonants	1 8 5 9 2 9 2 1	Total 37 equals 10, equals 1

Final total is 8 plus 1, equals 9

John's name-numbers, 8, 1, and 9 indicate, according to numerology, that his best chances for success lie along the lines of artistic endeavor. He has the support of courage, financial ability, and strength of character. Numerologically, he has an excellent name, and should not change it.

There are two numbers that are exceptions from all rules—11 and 22. They are not reduced to single figures but allowed to stand when they occur in a name, since they represent genius. The number 22 represents mystic power and beauty; 11, power and greatness.

EARTHWORMS as songsters! You think of them as grubbing creatures; but they may lift their cares in melody. A German zoologist, Professor Mangold, placed a dozen earthworms under a glass cover and to his surprise sounds of soprano pitch in rhythm came from within. There was no other source for the music present, declared the professor

Foresight Saves a Crash

(Continued from page 64)

cars that smashed into the wreck forgot the most important rule of the road. All they were thinking of was getting along in their own cars. What they should have done was to pay a lot more attention to what was likely to happen to the driver of the car ahead. Strong brakes are all right, but what good will they do you if you let yourself get caught where even locking all four wheels won't stop you in time?"

"But suppose you can't see what's going on beyond the car right in front of you?" demanded Joe.

"Then you should stay so far away from the car ahead that you'll have space to stop, no matter what happens. Look at that boob behind us," he directed, pointing to the reflecting mirror above his head. "If I stopped suddenly—or even slowed down—he'd ram me, sure as your name is Joe! He's not paying attention to his driving—he's admiring the scenery It's fellows like him that cause most of the accidents—if you ask me

"WHEN a man is driving a car, he ought to keep his mind on his job. And he can't do that if he insists on sight-seeing or turning around to talk to the people in the rear seat. I once saw a fellow run off a perfectly straight road and pile up in the ditch just because he insisted on talking to the passengers in the back. He was an old fellow and in his younger days he had driven a horse quite a lot. Horses stay on the road without being steered, and he couldn't get it in his head that an automobile wouldn't do likewise.

"The whole trouble is that so many drivers don't use any common sense in their driving. You can make all the traffic rules you want to, but they won't do much good unless the drivers of cars live up to 'em.

"That goes for special warning signals on the back of the car, too. What good are they if the man behind you doesn't pay attention? Most warning signals are set wrong anyway. The 'slow' or 'stop' sign flashes on the instant you press the brake pedal. They should be set so that the light will not flash until the brakes are actually applied hard enough to slow down the car. If warning signals were all set that way, then when an auto-driver saw a light flash up on the rear end of the car ahead of him, he would know that it meant business."

"You're dead right about warning signals," assented Joe. "But I thought they always were adjusted to light when the brakes went on?"

"They are when the car is new, but when the brake linings wear a bit, the average owner doesn't bother to readjust the switch on the warning light. And as for hand signaling, just take a look at that flivver in front!"

"Gosh!" said Joe. "Looks just like a centipede on its back! I wonder what they are going to do?"

"One, two, three—six hands out altogether—and no two pointing in the same direction!" Gus growled disgustedly.

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Foresight Saves a Crash

(Continued from page 159)

But in spite of all the hands, the flivver continued at a slow pace without swerving.

Gus jabbed the horn button viciously. The road was narrow and winding, and Gus did not want to have to go down into the ditch to pass.

Immediately the hands began waving wildly and then the flivver groaned and chattered as the driver brought it to a halt squarely in the center of the road.

Gus waited a moment, assuming that something had gone wrong with the heavily loaded little car, but no one climbed out and voices raised in a wrangle floated back.

"Can you beat it!" exclaimed Gus angrily. "Stopping right in the center of the road while they argue about whether they are going in the right direction!"

GUS kept his finger on the horn button and it finally dawned on the driver of the flivver that his car was blocking the road.

"That's the trouble with hand signaling," said Joe. "Half the time you can't tell what the car ahead is going to do even when the driver does stick out his hand."

"Yes," said Gus; "and if any signaling is to be done, the driver is the one to do it. Nobody else in the car should stick out a hand under any circumstances. Lots of times I have jammed on the brakes because the fellow in front stuck out his hand unexpectedly in such a way that I thought he intended to make a left turn, and then after I had burned a lot of rubber off my tires, he turned off the road to the right. Fashions in hand signaling are changing all the time and, to make it worse, the proper signal for one locality may mean something else when you cross the state line. Some day we'll have a standard system of hand signals for the auto-driver that will be enforced all over the country. Meantime the only thing to do is to play safe, so that no matter what the signal means you will be able to avoid a smash-up."

"Seems to me," commented Joe, "that a lot of signaling is unnecessary."

"It sure is, and usually the better the driver the less signaling he has to do. If you keep on the right side of the road where you belong and you make a turn into a road at the right, there's no reason why you should signal at all unless you have to slow down quite a bit to make the turn. Then if you make a habit of coasting to a stop and always slowing down as gradually as possible, the man behind doesn't need any signals."

"Well here we are at Turner's Corners," Gus concluded, as they pulled up in front of a ramshackle building that housed the post office and general store.

They climbed out and Gus started to assemble his shotgun.

"There's just one sure rule for safety in auto-driving, Joe," Gus sagely observed, as he carefully fitted the barrels to the stock: "Know the rules of the road yourself and live up to them, but don't ever bank on the other fellow having any sense! Now for some good rabbit shooting!"

Every Day's Work a Gamble with Death

(Continued from page 30)

planks and rails, but we had to guess where to put them and we had to tie them together because no wood would stay up in that mess. The water was up over the box cars. All you could see of some houses were the peaks.

"We worked night and day, 170 of us, anchoring wooden bridges down in the mud with steel rails and hoping to God we'd anchored them in the right places. It was terrible work, no rest, no decent food, no place to sit down and relieve your aching muscles. Only hollering women and shivering kids. And soldiers riding around in rowboats. Well, it was just seven months before I got home.

"THE old double-decked suspension bridge over Niagara Falls was another tough job. It's always hard to get materials over rushing rivers—and, of course, a slip means death. Wind hazards on bridges are always considerable. The Quebec span, which fell twice, took a lamentable toll of life. On the other hand, several important bridge spans have been erected without accidents: the Philadelphia-Camden suspension bridge, greatest in the world, the famous Bear Mountain Bridge, 400 feet above the Hudson; the great Queensboro Bridge, which connects Manhattan and Long Island City."

Diehl has had his accidents, too. Once, at James River, Va., he fell 65 feet, and while it may not sound like a soft landing spot, he was mighty grateful to come down on a pile of iron cross rods. They bounced him up and down, and although he couldn't work for a month and was arnica from head to foot, he's alive to tell and grin about it. Another time, when he went into emergency ship construction at Port Newark during the war, on what was known as "Fancy Ship 18," a 8½-ton plate hit him and broke both his ankles. He knows, too, how it feels to have four ribs broken.

Up to 10 years ago he was seldom home. The States, Mexico, Cuba, Brazil, Canada, all claimed him. And yet he didn't travel as widely as some. Quite a few American bridgemen have worked from Alaska to South Africa.

The work that appeals least to Diehl is New York's subways.

"You're being showered all day long," he says. "Dirt and muck from the street above down your back and in your eyes. All day long the stuff comes down on you, till you think you'll go crazy. But it's not dangerous work, because you can't fall far. Some of it's hard work, because very often heavy tonnage has to be handled to support buildings overhead. The Commodore Hotel and the Bowery Savings Bank, on Forty-Second Street in New York, are both sitting on subways.

"The elevated was much more fun. That was something like bridge work. Back in the eighties I worked on one of the first elevateds. In those days we used wrought iron and we had to hammer by hand the rivets that held it together.

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Every Day's Work a Gamble with Death

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We had no such things as pneumatic riveters or compressed air. And we had to do 500 rivets a day. Nowadays if you get 500 rivets out of a man using a riveting gun you're lucky."

Up in the air any sort of a job in wet or cold weather is treacherous.

"The men can't work properly in winter," says Diehl. "Let a drop of rain come down in cold weather and you see the boys come hurrying down. You can't blame 'em. The instant a drop of water touches cold steel it turns to ice. And a beam is hard enough to walk on when you've got everything in your favor.

"Nowadays we believe in taking as few chances as possible. In the old days, the boys used to love to give the crowd a thrill. They'd take unnecessary chances on the beams, they'd ride the ball, they'd go up and down with iron, grand-standing. I never let any man of mine ride steel. And I won't let any bell-ringer of mine tolerate it when I'm not around. No, siree. Suppose the engineer has a sudden attack of heart failure and takes his hand off the throttle? Say it with flowers!

"Because we don't take the chances we used to, hardly any one gets hurt nowadays. Of course, the men always are getting their hands and fingers jammed, or getting clipped with rivets, or getting bumped by swinging girders. But they don't really get hurt much any more. There were only a few killed the country over last year on steel jobs."

IT'S a wonderful trade, this fashioning of great buildings. And it happens to be peculiarly American. A half century ago, when Diehl ran away from home to his first job, masonry construction towering nine stories was considered the maximum for safety and utility. Then with Bessemer steel and, later, open-hearth steel, a material that would perform with mathematical exactness, the sky became the limit. Bessemer steel, developed between 1850 and 1860 by Henry Bessemer in England and William Kelly in America, was the first really economical steel, for by passing air through melted cast iron in a converter they showed how to remove impurities from the molten mass in 15 minutes. Open-hearth steel, developed by William Seimens in 1860, did the same thing only better, bringing forth from a gas-burning furnace a product virtually uniform in chemical and physical properties.

Both processes have made possible the economical casting of large ingots from which various shapes can be rolled. They have made possible the vast network of steel girders that will form the world's largest office building near the Grand Central Station. They have made possible, too, such gigantic projects as the great bridge across the Hudson River, for which the first preliminary survey has just been completed, and the world's loftiest skyscraper, newly planned to rise above the Woolworth Tower.

And so on with the joy-ride!

How a Cowboy-Aviator Hunts Wild Horses

(Continued from page 17)

western tribes, and these animals, escaping in turn, became the nucleus of the wild-horse bands that now wander northward as far as Montana.

While most of these horses—especially in the northern states—are of the ordinary mustang type—small, shaggy, and unbeautiful, but capable of great endurance—often there will be "throwbacks" that show Arabian blood in every line of conformation and in color. Such "throwbacks" make up the wild bands of pintos (the Spanish "paint"), which are the spotted horses commonly associated with the circus. Occasionally an entire pinto band will be found roaming from one water hole to another in the desert regions. They are as fleet and cunning as they are beautiful, but they are looked upon as rare prizes today, for they have been hunted so extensively that few of them remain.

"IT'S a queer thing about a horse band," said Chance Parry. "Some of the horses will make first-class saddle animals and others in the same band never can be broken. I've taken a first-class saddle horse from a wild bunch—a horse that was easy to break and a first-class horse to ride. In the same bunch I've picked up an outlaw that never can be ridden and now is being featured as a bucket at rodeos.

"If a rider gets near enough to rope a wild horse, he sees that the end of his rope is made fast to the surcingle, which is all his mount carries in the way of trappings, besides the bridle. If he ropes the horse, the rider may get a bad spill. Or the horse may fall and break a leg or perhaps its neck. A band of wild horses may run in numbers from six to 30 or 40. Each band is under the leadership of a stallion. It is that stallion's job to look after the welfare of his band.

"If it wasn't for the fact that they are driven to the water holes by thirst, the horses never would be caught in any great numbers by the present methods. The best way to catch a band is to build a trap at a water hole. But after the trap has been built, the work has only begun.

"A TRAP is a big corral, with a smaller one inclosed, for the branding. After the trap has been built, everybody deserts the water hole, except one man, who is left on guard, concealed in a pit. It is his job to put up the corral bars, in case the horses walk into the trap. He may have to lie hidden there a day or two before a wild horse band comes in to drink.

"The horses come in slowly, because things don't seem right to the stallion, who doesn't like the looks of the corral. If the wind is in the wrong direction, the stallion will sniff suspiciously and then make off, the whole band following. I believe a wild horse has the keenest sense of smell of any animal.

"Once we had our eye on a certain band of horses and built a trap at a water hole. The stallion was suspicious from

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How a Cowboy-Aviator Hunts Wild Horses

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the start, and when he finally brought the band to the hole, we knew the animals had been without water for five days. They came in slowly, the stallion leading. They were at the top of a hill several hundred yards away, when the man who had been left at the trap raised his head slightly. He ducked down instantly.

"The movement took only a fraction of a second, and the man hardly showed the top of his head above the sagebrush. But, quick as he was, the eye of the stallion was quicker. The leader of the band turned and ran, and the other horses followed. They were almost perishing for water, but the stallion led the horses to another water hole 35 miles away, just because he had seen that one suspicious move.

"LIKE other animals, wild horses are crazy about salt. We captured one of the finest bands of horses I ever have seen, simply by scattering blocks of salt around in a corral. We had built the gate of the corral so it would swing inward and close itself by its own weight. The horses were eager to get the salt, but the stallion was suspicious and held them back. Finally the stallion concluded that everything was all right, and pushing the gate open, began licking the salt. The mares and colts followed, one by one, and pretty soon we had the whole band trapped.

"But after you get a wild horse in a corral, it's no cinch that you're going to slap your brand on him. The wild horse is a great jumper and he will risk his neck to make a getaway. Once I trapped a mare and two colts. They were beautiful animals and I was shaking hands with myself when I got them in the corral. I put up three bars of the gate, working from inside the corral, and I thought the horses were as good as mine. The mare kept trotting around the corral, with the colts following. I needed another bar or two to make the gate the full height of the corral, but it was a good six feet as it stood.

"The mare however, concluded that the gate was not going to be built any higher. She made a dash at me as she came around the corral. Her ears were back, her teeth were showing, and fire was shooting from her eyes. I knew she meant murder if she could get me within reach of her hoofs, so I climbed the corral fence and didn't lose any time getting to the top. The mare dashed past me and with a mighty jump cleared the top of the gate just like a bird, and the colts followed—just like two more birds. If ever horses gave any one the laugh, they gave it to me as they galloped away from the trap at that water hole!"

UP TO four years old, there is some chance of making a good saddle horse or work animal out of a wild horse. After that age, a wild horse is always a wild horse. He may be broken and he may travel along with you all right, but he will always be looking for a getaway.

(Continued on page [illegible])

How a Cowboy-Aviator Hunts Wild Horses

(Continued from page 164)

"I had one particularly fine horse that was about five years old when I caught him," Parry went on. "But he was so good that I thought I'd take a chance on breaking him and making him over into a good pack animal. I kept an eye on him for a while, but he was so docile that he fooled me.

"Then, when I was out on a long trip, this fellow pulled his picket pin one night and left me with a heavy pack to distribute among the other pack animals."

When a wild horse gets away from you after you think you have him broken, you can generally figure on his taking one or more of your other horses along.

IN SOUTHERN Utah I was told of a big band of wild horses that caused ranchmen tremendous trouble by recruiting from domestic stock. At its head was a big battle-scarred roan stallion. Seen through field-glasses, these scars bore mute testimony to his supremacy as a leader. For among wild horses a stallion can continue as a leader only as long as he can defeat contesting stallions.

This big roan was wise and speedy as well as an able fighter, and it was a big job to catch him, but finally he and his whole band were trapped. When the bunch was corralled, it was discovered that the horses carried brands of ranchers in several different parts of Utah. That stallion had recruited his band, one by one, and found loyal supporters even among horses born and bred on the ranches. And these latter were just as wild as the others.

"But not all the ranch horses listen to the call of the wild," said Parry, smiling reminiscently. "And there's nothing like a good old dependable work horse, that likes alfalfa better than slim picking on the range, to take the nonsense out of some of these wild horses.

"When we capture a promising lot of young horses, we frequently take a couple of them and fasten them on either side of a faithful old mare. Tied head to head, we turn the three of them out on the range. The young horses start at once for freedom, dragging the old mare along with them. For a while the wild horses have their own way, dragging the old mare along with them. Then the strain begins to tell on them.

"Along about evening the three horses show up at the ranch, the old mare bringing the wild horses along with her. And maybe those bronchos aren't tired! After three or four days of that kind of thing, they are willing to listen to reason."

In spite of the constant search for them by hunters like Chance Parry, in spite of their being shot by hundreds at water holes, rounded up and exterminated by thousands in Montana, I believe that wild horses will continue to roam the Western plains for many years. Not even Parry's plan of hunting them out by airplanes will totally eliminate these splendid animals from the rugged Colorado River plateau, where they have run in freedom for hundreds of years.

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AUTHORS AND MANUSCRIPTS

[illegible] story ideas wanted. [illegible] paid. Experience unnecessary; outline Free to anyone. Write Photoplay League, [illegible] St. Louis.

[illegible] stories, poems, plays, etc. are wanted for publication. Literary Bureau, [illegible] Hannibal, Missouri.

$[illegible] FOR ideas. Photoplay plots accepted any form; revised, criticized, copyrighted, marketed. Advice free. Universal Scenario Corporation, 214 Security Bldg., Santa Monica and Western Avenue, Hollywood, California.

I WANT song poems. Casper Nathan, [illegible] No. [illegible], Chicago.

SONG Poem Writers send for proposition. Ray Hibbeler, D-[illegible], 4040 Dickens Av., Chicago.

SHORT Stories, Articles, etc. [illegible] and marketed. [illegible] Service, Dept. [illegible], Harrisburg, Penna.

[illegible] song poems wanted. [illegible] Publicity Bureau, Box 44, Times Square Station, New York.

AUTOMOBILES AND ACCESSORIES

DELIVERY bodies for Ford Model T Chassis with [illegible], suitable for Contractors, Grocerymen and Farmers. Three styles. Price $37.50. Write Daniel Kinnamon, Craigville, Indiana.

AUTO Body Polish makes [illegible], a [illegible] less than pint bottle. Formula $1. [illegible] Sales Co., 1442 East 118 St., Cleveland, Ohio.

AVIATION

The American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 6741, 3601 Michigan Ave., Chicago, Illinois.

LEARN Aviation! Send 25c for large illustrated Catalog. Varney Aircraft Co., Peoria, Ill.

LEARN to Fly. America's Largest Strictly Commercial Organization. High class [illegible] instruction without Traffic [illegible]. Write for further particulars. Johnsons' Flying Service, Inc., Dayton, Ohio.

BLUEPRINTS

To the man who has a Home Workshop and likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. [illegible], Sewing Table; No. 5, Kitchen Cabinet; No. 12, Toy Wagon; No. 15, Workshop Bench; No. 17, Cedar and Mahogany Chest; No. 41, One Tube [illegible] Set; No. 42, Radio Receiver with three stages of amplification; No. 43, Four Tube Radio Receiver. Send 25c for each blueprint that you wish to Popular Science Monthly, 250 Fourth Avenue, New York, N. Y.

BOATS AND LAUNCHES

BOATS that always go are propelled by Ford engines. Fold[illegible] free to boat owners. Harry Rider, East Norwalk, Conn.

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HAVE you received a copy of our new [illegible] page "Ham" Bulletin? Hundreds of rare bargains in transmitting and receiving apparatus. Write for copy Free today. Chicago Salvage Stock Stores, 509 So. State St., Dept. P. S. 6, Chicago.

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MR. ADVERTISER. Ask today for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the Jan. 1926 issue should be received by Nov. 5th

Prize Winners in September Contest

The first prize of $10.00 goes to James Montague of Canton, Ohio, for his letter on E. Palmer's advertisement. Here is Mr. Montague's letter:

> Dear Sir:
> The advertisement of E. Palmer, under Money Making Opportunities, appeals to me the most, for it tells the pleasure and also from the profit part of it. There is also the chance of freedom instead of slaving in a shop. Since I have answered his advertisement I have had all the above besides meeting on an equal footing [illegible] the best people. Every advertisement in Popular Science Monthly should be closely studied by everybody.
> James Montague

Mr. George L. Heath, Chicago, Illinois, wins the second prize for the following letter on the advertisements for "District Managers and Representatives Wanted." This is his letter:

> Dear Sir:
> [illegible] When an advertisement is the means of leading over $[illegible] in nine months besides establishing a permanent business, the one concerned should be interested. [illegible] That is why I am so interested in the advertisements under "District Managers and Representatives Wanted." A successful future is ahead of me through answering an advertisement under this column.
> Very truly yours,
> George L. Heath.

The third prize goes to Mr. Cecil C. Kerr, of Fremont, Va., for his letter regarding the American Monogram advertisements. This is the letter:

> Dear Sir:
> I am interested most in the advertisement that says make [illegible] to fifteen dollars daily putting gold initials [illegible]. The reason I am interested in that advertisement is that I sold every automobile owner a [illegible] gold [illegible] for his car in less than two weeks. This made me a pretty good little pile of money just in my spare time.
> Very truly yours,
> Cecil C. Kerr

The winners of the other seven prizes and the names of the advertisers they wrote about are:

Wilbert Whitfield, Fremont, Nebr. (Motorists Accessories Company)

Robert T. Williams, Boise, Idaho (Home Advertising)

C. W. Boyle, Roseburg, Oregon (Typewriters & Supplies)

Albert J. Bechlen, Chicago, Illinois (Chalk Talk, Cartooning ads)

W. E. Stobbe, Cleveland, Ohio (American Photography)

Dudley Turner, Holly Springs, Miss. (F. C. Gale)

M. G. Bowen, Taft, California (W. T. Green)

BUSINESS OPPORTUNITIES

PATENTS procured. Trade Marks Registered. A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 41 Owen Bldg., Washington, D. C., or 41-Z Park Row, New York.

FREE Book. Start little mail order business. Pier, 974 [illegible] Street, N. Y.

LEARN the collection business. Good income, quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

BECOME a Foot Correctionist. A New Profession not medical nor chiropody. All the trade you can attend to; many are making $[illegible] to $[illegible] yearly; easy terms for training by mail; no further capital needed or goods to buy; no agency or soliciting. Address Stephenson Laboratory, 10 Back Bay, Boston, Mass.

WE start you in business, furnishing everything. Men and women, $30.00 to $[illegible] weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

GOLD, Silver and colored Sign Letters for windows, automobiles, trucks. Make them yourself with our Process and Letter Patterns. Fast sellers. Big profits. No experience. Stamp brings actual sample. Wil-Felling, [illegible] Street, Oak Park, Illinois.

STOP "bossing." Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipment. $[illegible] up. Book of Opportunity free. Haywood's, 1400 South Oakley Avenue, Chicago.

START small home Mail Order Business. Booklet 3c. Harvey Teeple, Decatur, Indiana.

START for yourself. Be independent. We show you how. The mail order way. Send $1.00 for instructions. [illegible] 131, [illegible], Windsor, Va.

$[illegible] A week evenings. Mail Order Business. Booklet tells how. Sample and plan 25c. Free 6 articles worth $4. [illegible] Co., Shawnee, Okla.

MR. ADVERTISER. Ask today for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

MANUFACTURE Dry Chemical Fire Extinguisher. [illegible] demonstration makes sales. Formula $1.00. [illegible] Way, Long Beach, Cal.

PATENTS commercialized. D. & H. Auto Products Co., Indianapolis, Indiana.

THE Great Wheat Secret. New book showing the cause of wheat swings and how to forecast them. Unequalled method for traders, speculators, millers. Trading folder free; write today. Market Forecaster Co., Dept. [illegible], Box 174, Topeka, Kansas.

LEARN Furniture. Big profits waiting in every community. Easily learned at home in your spare time. Get into a high-grade business for yourself. Uncrowded field. No peddling or soliciting. We teach you. [illegible] Write today for free book and full particulars. [illegible] stamps, mailing cost. No obligation. [illegible] Suite 1735, [illegible] Lincoln, Neb.

BUSINESS Guide with free legal service [illegible] everywhere. We [illegible] $[illegible] in 25 days. Write for free [illegible] Virginia Co., Naples, [illegible].

$[illegible] WEEKLY income starts immediately; particulars free. [illegible] 14, The Arcade, Cleveland, Ohio.

BATTERY shop equipment and supplies at wholesale. Adams-Barre, Columbus, Ohio.

A new mail order book tells exactly how to start, grow and win. [illegible] methods explained; new ideas and schemes. Free circular tells all about it. Martin, Publisher, [illegible] Bldg., Portland, Oregon.

[illegible] out of the [illegible]. $[illegible] sufficient. Learn [illegible] trading. Dept. [illegible], Paul Kaye, 149 Broadway, N. Y.

I WILL start you in business. Free Particulars. Robert Johnson, Clearfield, [illegible].

MAKE Money. [illegible] FREE! Wolverine Bureau, [illegible], Muskegon, Michigan.

SUCCEED With Your Own Products, make them yourself. Formulas, Processes, [illegible]. Trade-Secrets. Modern market methods. Catalog free. C. Thaxly Co., Washington, D. C.

RE[illegible] $20 daily [illegible] profit, exact method we use, particulars for stamp. Dennee, 1222 E. 49th, Los Angeles, Cal.

USED correspondence school courses. All kinds. Sold on re-purchase basis. Big saving. Money back guarantee. Lists free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

MIRRORS resilvered at home. Costs less than 5 cents per square foot; you charge 75 cents. Immense profits, plating auto parts, reflectors, tableware, stoves. Refinishing metalware, etc. Outfits furnished. Write for information. Sprinkle, Plater 94, Marion, Indiana.

YOUR ship will never come in unless you send it out. European Bonds. "The Venture of the Century," bought [illegible] cash or installments. Information without obligation. Frank C. Everett, 38 Wall St., New York.

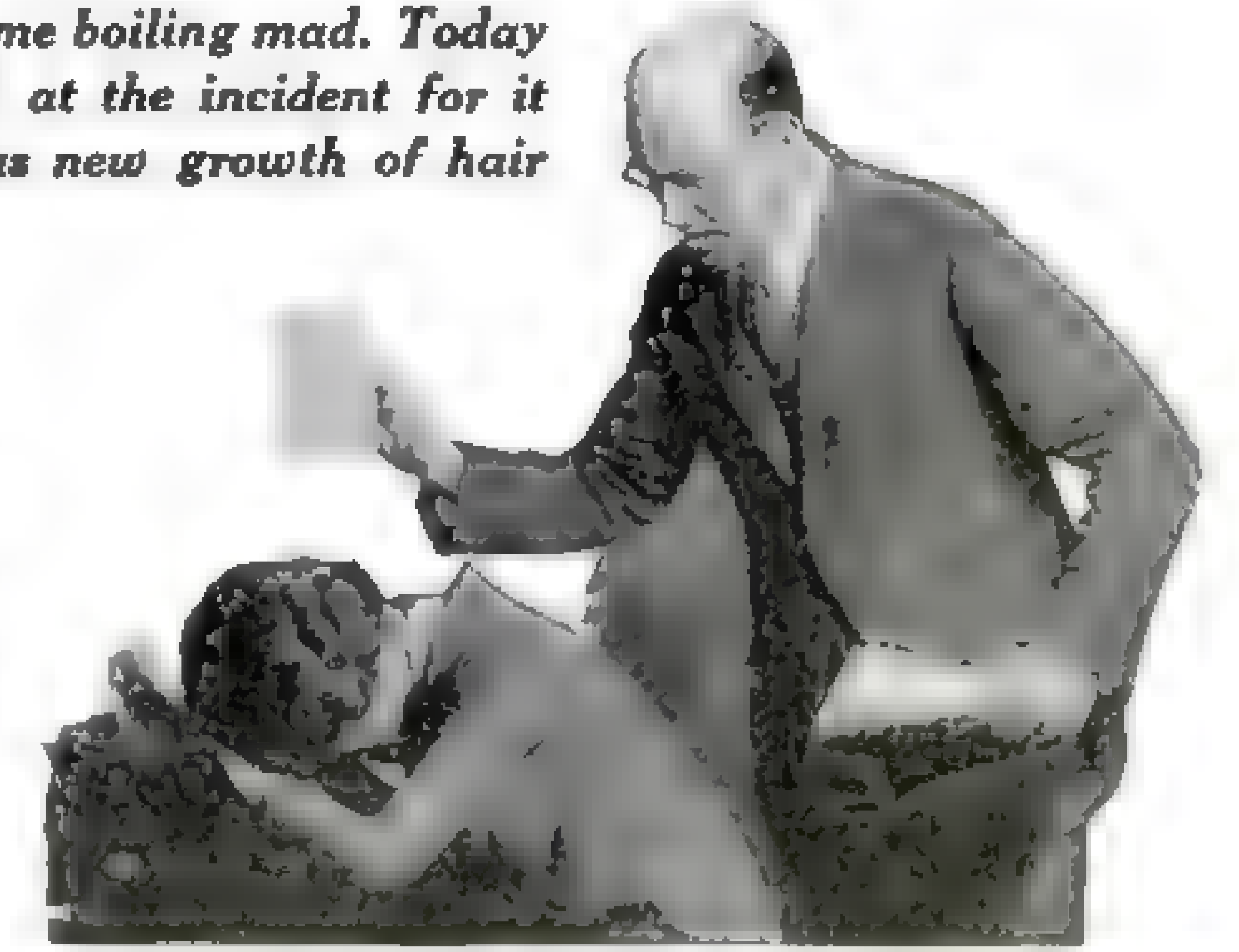
AVERAGE $1.00 and up per hour refinishing furniture. Previous painting experience useful but unnecessary. Write today for particulars. Reitz Furniture Refinishing System, 605 Superior Bldg., Cleveland, Ohio.

START prosperous business. $1. Free circular. R. French, 1903 E. Chase, Baltimore, Md.

INCH Display Advertisement, 100 Magazines, [illegible], $20.00. Woods Popular Service, Atlantic City.

How a Strange Accident Saved Me From Baldness~

Sixty days ago it made me boiling mad. Today I look back and laugh at the incident for it brought me a marvelous new growth of hair



I'M willing to bet that I've wasted more money trying to end my baldness than any other man in the world. So naturally I laughed at any ad that sounded like a baldness remedy. And the oftener I laughed, the more bald I became.

When my wife began to look sorrowfully at my thinning hair I smiled regretfully. When my friends began to call me "baldy" I felt somewhat annoyed. But when my private secretary began to look strangely at my glistening scalp and snicker—well it made me mad.

But the worst was yet to come. About sixty days ago I saw a tooth paste advertisement that offered to send a free booklet. It sounded interesting so I clipped the coupon and gave it to my secretary to fill in and mail.

Well, a few days later, to my utter surprise, I found on my desk—not a booklet on toothpaste—but a booklet and a letter telling how to end baldness in 30 days!

I glanced from the booklet to my secretary. I felt my blood boiling.

"Miss Harris," I said to her, "I can't say that I appreciate your sense of humor. Just what is your idea? Is it . . . "

She paled. "Why, Mr. Burns—what's wrong—what have I done?"

"*Done!*" I shouted, "aren't you content with laughing at my bald head—must you make matters worse by sending me this hint. If it pains you to look at my head you are always at liberty to resign!"

Tears came into her eyes. And between sobs she explained why it wasn't really her fault.

She said that the coupon which I asked her to mail had another coupon printed on the back—and the other coupon offered to send a free book about baldness. Well, she simply used her own judgment!

"Hm," was all I could say. And during the entire day not a word passed between us.

But that night on my way home I read the book about baldness. And I have to admit that a more interesting, more helpful, more honest book I've never read in my life. It described an entirely new method of making hair grow — a method perfected by Alois Merke, founder of the Merke Institute, Fifth Avenue, New York. It is the only treatment I had ever heard of that actually reached right down to the hair roots and awakened them to new, vigorous activity.

As I read on I felt myself weakening in my resolve not to try another hair treatment. And then when I read that Merke actually guaranteed a new growth of hair in 30 days or no cost to me—well, I completely weakened and sent for the treatment.

The first two or three times I used the treatment I began to notice that my hair didn't fall out as much as it used to. But a week or so later when I looked in the mirror I saw something that almost bowled me over! For there, just breaking through, was a fine downy fuzz all over my head.

Every night I spent 15 minutes taking the treatment at home. And every day this young hair kept getting stronger and thicker. At the end of a month you could hardly see a bald spot on my head. And at the end of sixty days—well, my worries about baldness were ended. For I had regained an entirely new head of healthy hair.

Can you blame me for laughing now at the strange incident of 60 days ago?

Read This!

"Results are wonderful. My hair has stopped falling out and I can see lots of new hair coming in. I preach your system to everyone." F. D. R., Washington, D. C.

"My hair was coming out at an alarming rate, but after four or five treatments I noticed that this was checked. My hair is coming in thicker and looks and feels full of life and vigor." W. C., Great Neck, N. Y.

"I have used your system for eight weeks and although the top of my head has been entirely bald for six years, the results up to the present are gratifying. In fact the entire bald spot is covered with a fine growth of hair." W. B., Kenmore, Ohio.

(Originals of above letters on file at the Institute)

Here's the Secret

According to Alois Merke, in most cases of baldness the hair roots are not dead, but merely dormant—temporarily asleep. Now to make a sleeping tree grow you would not think of rubbing "growing fluid" on the leaves. Yet that is just what I had been doing, when I used to douse my head with common ordinary tonics, salves, etc. To make a tree grow you must nourish the roots. And it's exactly the same with the hair.

This new treatment, which Merke perfected after 17 years' experience in treating baldness, is the first and only practical method of getting right down to the hair roots and nourishing them.

At the Merke Institute many have paid as high as $500 for the results secured thru personal treatments. Yet now these very same results may be secured in any home in which there is electricity—at a cost of only a few cents a day.

The thing I like most about Merke is that he very frankly admits that his treatment will not grow hair in every case. There are some cases of baldness that nothing in the world can help. But so many others have regained hair this new way that he absolutely guarantees it to produce an entirely new hair growth in 30 days or the cost is free. In other words, no matter how thin your hair may be, he invites you to try the treatment 30 days at his risk, and if it fails to grow hair then he's the loser—not you. And you are the sole judge of whether his method works or not.

Coupon Brings You Full Details

This story is typical of the results that great numbers of people are securing with the Merke Treatment.

"The New Way to Make Hair Grow," which explains the Merke Treatment in detail, is the title of the vitally interesting 34-page book which will be sent you entirely free, if you simply mail the coupon below.

This little book tells all about the amazing new treatment, shows what it has already done for countless others, and in addition contains much valuable information on the care of the hair and scalp. Remember this book is yours free to keep. And if you decide to take the treatment you can do so without risking a penny. So mail the coupon now and get the surprise of your life. Address Allied Merke Institute, Inc., Dept. 1711, 512 Fifth Avenue, New York.

GET THIS FREE BOOK

Allied Merke Institute, Inc.
Dept. 1711, 512 Fifth Avenue, N. Y. C.

Please send me without cost or obligation, in a plain wrapper, a copy of your book describing the Merke System.

Name ....
(State whether Mr., Mrs., or Miss)

Address

City .... State........

BUSINESS OPPORTUNITIES

FORMULAS: Hair Tonic, Pomade, Shampoo, Cream, Dandruff Ointment $5.00 [illegible] each. [illegible] Box 302, [illegible] New York.

[illegible] manage office and salesmen. $300 [illegible] Address Manager, 518 [illegible] Bldg., [illegible]

LEARN Sign Painting, complete course. Thorough [illegible] Reliable. [illegible] Plans of [illegible] Wealth. [illegible] Minneapolis, Minn.

If you are looking for a money making [illegible] particulars [illegible]

BUSINESS SERVICES

CHARTERS [illegible] Free forms [illegible] Wilmington, Del.

MR. ADVERTISER: Ask today for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know wouldn't you? Address your inquiry to Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

CHALK TALKS

[illegible] Circulars free. [illegible] Oshkosh, Wisconsin.

DISTRICT MANAGERS AND REPRESENTATIVES WANTED

WOOLENS [illegible] Write today [illegible] San [illegible] California.

DISTRICT representatives [illegible] selling [illegible] Minn.

WANTED: [illegible] Purchasing Agents [illegible] Write Purchasing Manager [illegible]

AGENTS [illegible] United States today. [illegible] M & C Rubber Co., Dept. [illegible] Pa.

DOGS

[illegible] registered [illegible] Texas.

EDUCATION AND INSTRUCTION

[illegible] Courses. All Schools. Lowest prices. [illegible] Catalog Free. Mention Subject. [illegible] 448-H Mission, San Francisco.

LEARN watch, clock and jewelry repairing at home. [illegible] James [illegible] Watchmaker and Jeweler, [illegible] Market St., [illegible]

[illegible] Students' Exchange, Dept. A, 47 West [illegible] New York.

[illegible] bookkeeping [illegible]

[illegible] complete. [illegible] New York.

[illegible] Mail Course [illegible] College [illegible]

[illegible] Broadway, New York.

[illegible] Copyright Book free. [illegible] St. Louis, Mo.

[illegible]

FOR BOYS

[illegible] Publisher [illegible]

FOR INVENTORS

INVENTIONS [illegible] Albert E. [illegible] Washington, D.C.

UNPATENTED [illegible] and help you make [illegible] Write W. T. [illegible] Washington, D.C.

[illegible] Oregon.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

[illegible] Patents. Established in 1900. Charles A. Scott [illegible] Avenue, Rochester, New York.

INVENTIONS [illegible] St. Louis, Mo.

MECHANICAL Drawing [illegible] Engine [illegible]

[illegible] Cash for your patent or invention under our new plan. Write at once to Inventors Syndicate, [illegible] St. Louis, Missouri.

MR. INVENTOR: If you have a patent or invention for sale, Write [illegible] Central St., Bangor, Maine.

GET Your Own Patents. [illegible] Cooper [illegible] Campbell, Calif.

WANTED: Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

FOR MEN AND WOMEN

[illegible] Work home or travel. Experience unnecessary. Write George Wagner, former Government detective, 1968 Broadway, N. Y.

Did you know why women don't get bald? If your hair is thin [illegible] Frank Robinson, M.D. [illegible] West Washington St., [illegible]

FORMULAS

FORMULAS [illegible] The Formula [illegible]

ANY [illegible] Laboratory [illegible]

FOR SALE AND EXCHANGE

For Sale [illegible] bargain. [illegible] Jamestown [illegible]

[illegible] E. H. Hawkins, [illegible]

FOR THE HOME

[illegible] Weaving Looms only $9.90. Big money in weaving Colonial rugs, carpets, etc., from rags and waste material. Weavers are rushed with orders. Send for Free Loom Book. It tells all about home weaving and quotes reduced prices and easy terms on our wonderful new looms. Union Loom Works, 442 Factory St., Boonville, N.Y.

GRANDFATHER clock works $5.00. Build your own case [illegible]

WIRE your own home for electricity. It is easy. Save [illegible] I show you how, loan you the tools and can get you the material at wholesale prices. [illegible] Sigmund Parker, [illegible]

To the man who likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of articles [illegible] The following are a few of the blueprints available. No. 1 Sewing Table, No. [illegible] No. 11 Tea Wagon, No. [illegible] Workshop Bench, No. [illegible] Cedar and Mahogany Chest, No. [illegible] Radio Receiver [illegible] for each blueprint that you wish to Popular Science Monthly, 250 Fourth Avenue, New York, N. Y.

HELP WANTED

MEN: We can put you in touch with good paying [illegible] Popular Science Monthly, 250 Fourth Ave., New York.

[illegible] Metal Works [illegible]

[illegible] Detroit, Michigan.

[illegible] New York [illegible] Brush [illegible] New York.

[illegible]

[illegible] Company, [illegible]

[illegible] Popular Science Monthly, 250 Fourth Avenue, New York.

[illegible]

HELP WANTED-INSTRUCTION

RAILWAY [illegible] Chicago Civil Service College.

RAILWAY Mail Clerks [illegible] Rochester, N.Y.

MEN wanting [illegible]

[illegible] Travel. [illegible] Write George Wagner, former Government Detective, 1968 Broadway, N.Y.

[illegible] Brakemen, Baggagemen [illegible] Railway Bureau, East St. Louis, Ill.

HOW TO ENTERTAIN

PLAYS, musical comedies and revues, minstrel music, blackface skits, vaudeville acts, monologs, dialogs, recitations, entertainments, musical readings, stage handbooks, make-up goods. Big catalog free. T. S. Denison & Co., 623 So. Wabash, Dept. 38, Chicago.

INCORPORATIONS

INCORPORATE [illegible] Delaware [illegible] Market St., Wilmington, Del. Established 1900.

DELAWARE Incorporator. Charters. Free Pamphlet. [illegible] Orange St., Wilmington, Delaware.

INFORMATION

COMPLETE accurate information on any subject [illegible] National Information Bureau, 14200 [illegible] St., Grand Rapids, Michigan. Prompt service.

LABORATORY AND CHEMICAL SERVICES

GUARANTEED Science Formulas, Trade Secrets, Rare Dependable Manufacturing Processes for all lines, detailed working directions, inside commercial information. Don't buy until I've sent you my valuable literature. [illegible] Satisfaction Guaranteed. Dr. [illegible] Tampa, Florida.

[illegible] for all kinds of melting. $7.50 up. [illegible] Electric Furnaces, [illegible] Chicago, Ill.

CHEMISTRY supplies. Experimenter's catalog [illegible] Chemical Apparatus [illegible] 4406 West [illegible] Ave., Chicago.

[illegible] problems solved [illegible] Richards, [illegible] Boston, Mass.

MR. ADVERTISER: Ask today for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know wouldn't you? Address your inquiry to Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

LETTER SPECIALISTS

[illegible] letters, folders, booklets [illegible] for manufacturers, mail order dealers. Long experience. Write for details. [illegible] Box 546, Freeport, Ill.

LISTS

NAMES [illegible] 33 West 42nd St., New York.

AGENTS [illegible] World [illegible] W. Washington, Chicago.

MAGIC TRICKS

MAGIC [illegible] tricks. Catalog free. [illegible] Jefferson, Louisville, Ky.

MAIL ORDER BUSINESS

[illegible] business [illegible] Sample and plan 25c. [illegible] New York.

MANUFACTURING

PATTERNS [illegible] metal. Models [illegible] machine work [illegible] Write [illegible]

[illegible] Specialty Co., 2015 Elm St., Cincinnati [illegible]

[illegible] New York [illegible] See page [illegible]

MISCELLANEOUS

[illegible] N.Y.

WANTED: Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

ARE you old at forty? See our advertisement on page [illegible] of this issue. The Electro Thermal Company, [illegible] Main, Steubenville, Ohio.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

[illegible] Model Makers [illegible] Chicago [illegible] lowest prices. [illegible]

[illegible] Philadelphia, Pa.

MOTORCYCLES, BICYCLES, SUPPLIES

OVERSTOCKED! [illegible] Motorcycles [illegible] Must be sold at once [illegible] Dept. C, 15 [illegible] Boston, Mass.

[illegible] motor attachment until you get our catalog and prices. Shaw Mfg. Co., Dept. [illegible] Galesburg, Kansas.

[illegible] Bicycle Parts [illegible] Cycle Co., [illegible] North [illegible] St. Louis, Mo.

MR. ADVERTISER: Ask today for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

MUSICAL

SAXOPHONISTS [illegible] Complete Trumpeters [illegible] Free Folders. Virtuoso Music School, Buffalo, N.Y.

NOVELTIES

[illegible] seller. [illegible] sample and terms [illegible] Phila.

OFFICE DEVICES

ADDRESSING machines, multigraph, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, [illegible] N. Market St., Chicago.

OPTICAL GOODS

ARTIFICIAL eyes. Booklet free. Denver Optic, 509 Barclay, Denver, Colorado.

MR. ADVERTISER: Ask today for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know wouldn't you? Address your inquiry to Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

PATENT ATTORNEYS

PATENTS Procured. Trade Marks Registered. A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 41 Owen Bldg., Washington, D. C., or 41-J Park Row, New York.

PATENTS. Before disclosing an invention, the inventor should write for our guide book "How to Get Your Patent." [illegible] Three books mailed free to inventors. Our illustrated Guide Book, "How to Obtain a Patent," contains full instructions regarding patents. [illegible] Victor J. Evans & Co., 807 Ninth, Washington, D. C.

ESTABLISHED 1869. Milo B. Stevens Company. Free Booklet [illegible] Monadnock Block, Chicago. Barrister Building, Washington, D. C.

"INVENTOR'S Adviser," the valuable Patent book with 136 mechanical movements and illustrations, sent free upon request. M. H. Labiner, Patent Attorney, 3 Park Row, New York.

[illegible] patent attorney [illegible] Washington, D. C. [illegible] patent [illegible]

INVENTIONS [illegible] Lancaster and Allwine, Registered Patent Attorneys in United States and Canada, 232 Ouray Bldg., Washington, D. C.

[illegible] Washington, D. C. Patent Attorney [illegible]

PATENTS, trade marks, copyrights. Prompt personal reliable service. [illegible] Write for terms. Book free. [illegible] Nat'l Building, Washington, D. C.

PATENTS. [illegible] Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C.

[illegible] free on request [illegible] Patent Attorney and Engineer [illegible] New York.

PATENT Book Free. Charles W. Lovett, Patent Attorney, Lynn, Mass.

[illegible] W. T. Greene, 811 Jenifer Building, Washington, D. C.

[illegible]

[illegible] Washington, D. C.

[illegible]

[illegible] Patents [illegible] Washington, D. C.

[illegible] Patent Attorney [illegible] New York.

PHOTOGRAPHY AND SUPPLIES

[illegible] American Photography, 117 Camera House, Boston, 17, Massachusetts.

[illegible] Photographic [illegible] Dept. [illegible] 3601 Michigan Ave., Chicago.

MR. ADVERTISER: Ask today for a copy of the [illegible]

PRINTING, ENGRAVING AND MULTIGRAPHING

[illegible]

[illegible]

[illegible] Wolf Roll Labels [illegible]

[illegible]

[illegible] The Courier Company [illegible]

[illegible] Kankakee [illegible]

EARN [illegible] Magazines [illegible]

REAL ESTATE, ORCHARDS

[illegible]

THE Real Estate [illegible]. This book gives a most comprehensive yet most concise arrangement of useful facts about buying, selling, leasing and subletting of Real Estate, conveyancing, the erection of houses, mortgaging, transferring [illegible] pages. Price $2.00 postpaid. Popular Science Monthly, 230 Fourth Avenue, New York City.

SALESMEN AND AGENTS WANTED

[illegible] 551 Harvard St., Rochester, N. Y.

[illegible]

[illegible] Mallard Chem. Co. [illegible] St. Louis, Mo.

[illegible]

AGENTS [illegible] Metallic Letter Co. [illegible] Chicago.

[illegible]

[illegible]

[illegible] Laboratories, Dept. 27 [illegible]

[illegible]

[illegible] Popular Science Monthly, 230 Fourth Avenue, New York.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Madison Mills, 503 Broadway, New York.

[illegible]

[illegible] Tribune Building, New York.

INSTANT [illegible]

[illegible]

[illegible]

[illegible] 1160 S. Washington, Chicago.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Magnus, Michigan.

[illegible]

[illegible]

SALESMEN AND AGENTS WANTED

[illegible] Robert H. Ingersoll & Bro., [illegible] New York City.

[illegible] salesmen for union made hand tailored, all wool suits [illegible] Write Harvey [illegible] Chicago.

[illegible] Sample $1.00 retails $15.00 [illegible]

[illegible] St. Louis, Mo.

FREE sample [illegible]

[illegible] New York.

[illegible] L. Mitchell [illegible]

[illegible] Dept. 31, 4422 Lincoln Avenue, Chicago.

[illegible] Chicago [illegible]

[illegible]

[illegible]

[illegible] Washington, D. C.

[illegible]

[illegible] Particulars free [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Popular Science Monthly, 230 Fourth Avenue, New York.

TAKE orders for coffee, sugar, flour, meats, canned goods [illegible]

[illegible] American Accessories Co., Dept. [illegible]

[illegible] complete outfit [illegible]

[illegible] American [illegible]

[illegible] Lightning Co., St. Paul, Minn.

[illegible]

[illegible] Madison Textile Company [illegible]

[illegible] Write for free circulars. Murphy, [illegible] Calif., Box 2.

National Electrical Students Win Big Pay Jobs

We show YOU, too, how to make big money

"SIX Months at National Saved Me SIX Tedious Years as Apprentice"

"I have just passed Electrical Inspector's Examination and Electrical Repairmen's Examination for Civil Service with high grades. Only 27 men out of 136 passed the Inspector's Examination. I was eighth highest in Repairmen's Examination out of 126 men.

"Now I have several splendid positions open with big-pay and advancement. Yet I trained for only six months at National—and can fill these jobs better than other men who have worked for years as apprentices. I saved six years work by going to National and I am certainly thankful I decided to take your short cut to success." Alex Johnson

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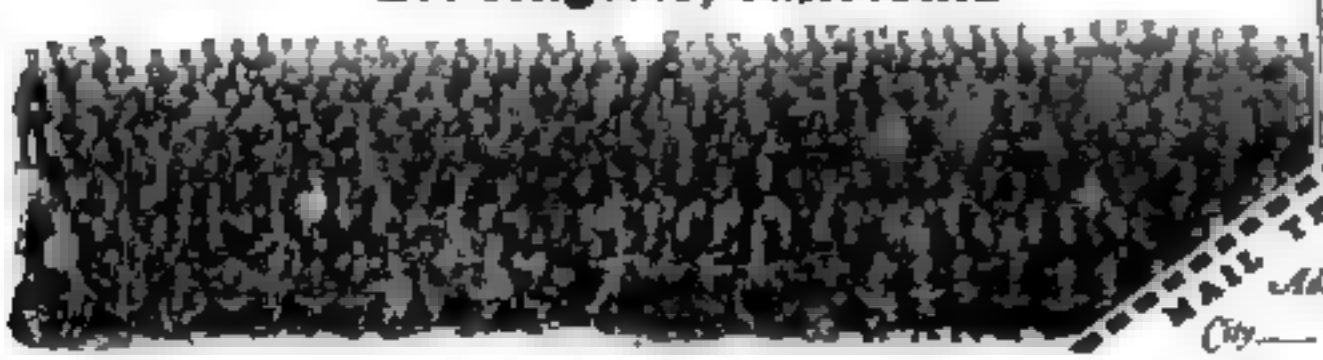

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The Battle of the Ants

(Continued from page 23)

the intricacies of higher calculus; but he does seem to be able to count, and that is more than a lot of animals can do. For instance, Ormond Francis Williams, an ant expert of Bridgeport, Conn., tells how on a walk in the woods one day, he kicked over a stone with his foot and uncovered numerous cocoons in which the pupae were developing. He picked up a couple with a small twig to investigate them. Meanwhile the excited ants below began to carry their treasures off to the nest. They took away all the pupae that remained on the ground. Then they came back and looked around. They could see nothing more to get, but still they hunted. The ants evidently had counted the pupae and knew there were just two missing, for when the latter were put on the ground again they were seized and carried off.

THE ant is the perfect nursemaid. As soon as the queen has laid her eggs, workers come scurrying to the spot. Each one seizes an egg in his mouth—holding it very gently—and carries it to a specially prepared chamber, warm and moist.

Once there, they classify the eggs according to sizes, and when the larvae emerge, they are placed in a circle with their heads pointing away from the center, so that the nurses can hurry around the outside and give them nourishment.

There is a species of ant in the tropical countries that takes its young outside on nice warm days, and parades them up and down, just like the nursemaid-baby-perambulator combination so common in the human race. The ant nursemaids are even more insistent on cleanliness than are the human species. They keep in the nest a sort of moist sponge made out of various soft materials, and whenever a young ant gets its mandibles all dirty or splashes mud on its antennae, the nurses hurry it to the sponge and wipe its face.

IF WE could find some way to make an ant unbosom himself and, speaking right out from the heart, tell us which of his various marvelous accomplishments makes him proudest, he would probably say, "My strength!" and then laugh at us condescendingly. For the ant is such a wonderful all-round athete for his size and weight that he makes the most powerful man on earth appear a weakling.

Here is one of his lesser feats as described by the naturalist, A. D. Du Bois. An ant was observed carrying a pebble from the bottom to the top of a mound. The ant and pebble were weighed, and the height of the mound was measured. For a man to do an equivalent piece of work in proportion to his size, he would have to carry a trunk weighing half a ton up 25 flights of stairs.

If that seems marvelous, consider this: A little field ant, in a carefully arranged laboratory test, held in his jaws a weight 3000 times heavier than itself, without difficulty. For you or me to equal that, we would have to be able to stand calmly on the edge of some convenient

(Continued on page 174)

The Battle of the Ants

(Continued from page 173)

precipice while eight freight cars loaded with iron dangled from a chain passed over our lower jaw.

A well-known entomologist has asserted that if any man weighing 150 pounds had the same strength in porportion to his weight as the ant has, he easily could hoist two of the largest modern locomotives on his back and walk away with them, without even staggering.

There is a species of ant in Africa called the "bulldog," which Professor Wroughton tells us, can travel along in great leaps a foot long. If modern man wishes to emulate this achievement, he will have to increase the present broad-jump record from slightly over 26 feet to 144 feet.

The ant is a farmer. It may sound unbelievable, but he has his own gardens that he cultivates, and in which he raises special foods found nowhere else; and he has "stables" wherein he keeps "cows," which he "milks."

Consider, for instance, the ants called the "leaf-cutters." They slash off leaves from trees with their sharp mandibles, carry the leaves down into the nest, and there chew them up into a fine paste that they spread on the floor. Meanwhile other ants have been hunting mushroom slips, which they now carry in and plant in the prepared "soil." The result is a fungous growth that seems to be one of the favorite ant foods.

THE ant's "cow" is the aphid, the green-fly of our gardens. The ant seizes these little creatures, takes them to the nest, and there shelters them and feeds them. In return for this, the aphids give off a honey-dew "milk" when stroked by the ant's antennæ, and this honey-dew is the ultimate in beverages for the ant.

Did you ever think of the ant as a surgeon? He is, though his operations are rather heroic. Among the Brazilian leaf-cutters the following technic is employed: When a patient is brought in suffering from a bad wound, the ant surgeons catch a few huge soldiers who won't be missed, and, holding the edges of the wound close together, induce a soldier to close its jaws in them. The unfortunate soldier then is decapitated. A number of these "stitches" are put in, according to the length of the wound, and they remain firmly locked and the wound is healed fully. One well may question whether the disease is worth the cure.

Finally, we may note that the ant has that trait so extremely rare among animals—he buries his dead in a cemetery, and with a regular funeral procession. Members of the colony lift the dead body with their mandibles, and, others following in solemn line, they go outside the nest to the little plot of ground where they bury their corpses.

There is much more that this marvelous little creature, such a wonder-worker for his size, can do. In the rôles in which we have considered him we have seen him versatile beyond all belief. As to what other wonders he would make known to us if only he could talk, we can but guess.

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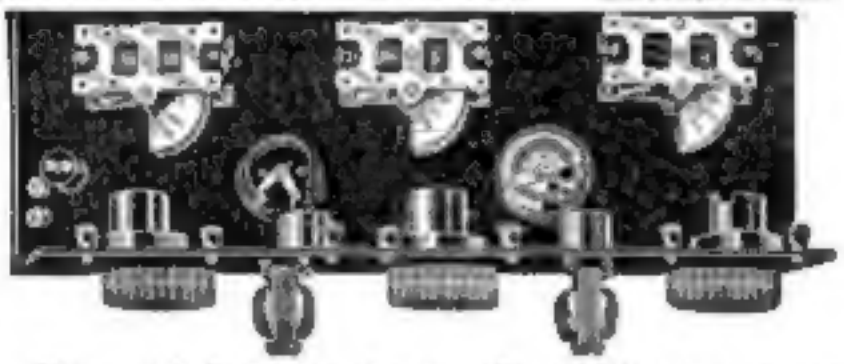

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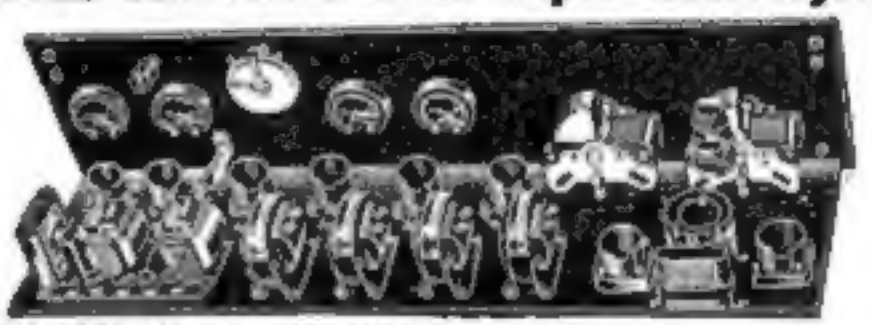

World's famous 8-tube Super-Heterodyne

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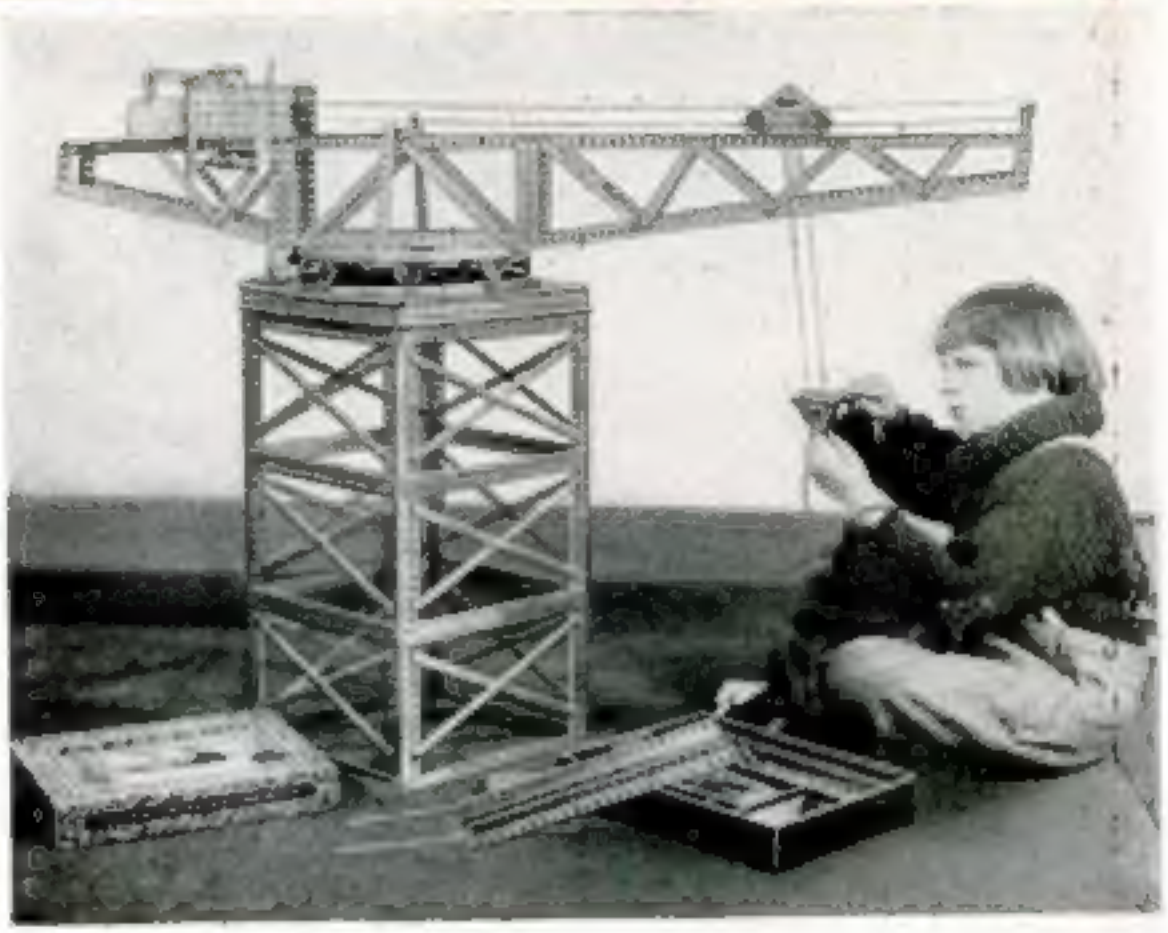
"I have been a Meccano Fan since I got my first set"

Jackie Coogan



Having a choice of all construction toys, Jackie Coogan selected Meccano, the original and "the Daddy of them all." More than once between pictures Jackie has been found finishing a Meccano model which he has designed himself.

You, too, can share in this Meccano fun. You can build towers, cranes, bridges, steam shovels—anything you can think of, but you must have the real Meccano.

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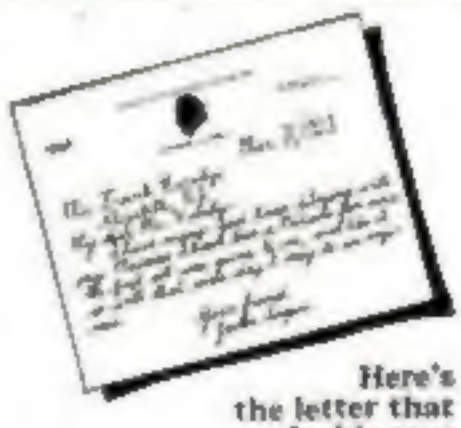
Meccano has a part for every purpose—more than 200. That's why it will build more models than any other toy. There are strong steel strips, with holes every half inch to make building easy; solid brass pulleys and gears; couplings, curved strips and many others. Other toys have copied some of these parts, but only Meccano has them all—that's how good Meccano is. Be sure you get the original Meccano every time.

In every Meccano outfit is a big book full of pictures of models. The fun begins as soon as you open your set.

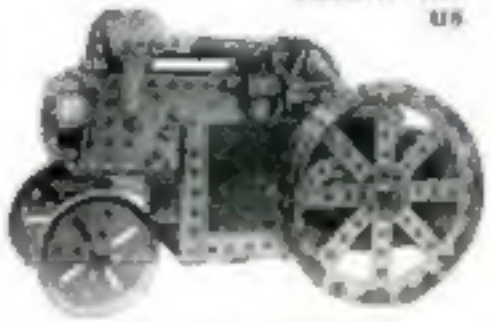
Yes, Jackie is enthusiastic about Meccano and you fellows will be, too, when you get your outfit. Ask Dad to give you Meccano and then—Oh Boy!

MECCANO

Engineering for Boys



Here's the letter that Jackie sent us



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